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Evaluation of the 2004 Predictions of the Run-timing of Wild and Hatchery-Reared Salmon and Steelhead Smolt to Lower Granite, Rock Island, McNary, John Day, and Bonneville Dams using Program RealTime

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MONITORING AND EVALUATION OF SMOLT MIGRATION IN THE COLUMBIA BASIN
VOLUME XII

Evaluation of the 2004 Predictions of the Run-Timing of Wild and Hatchery-Reared Salmon and Steelhead Smolt to Lower Granite, Rock Island, McNary, John Day, and Bonneville Dams using Program RealTime

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Monitoring and Evaluation of Smolt Migration in the Columbia Basin

Other Publications in this Series

Volume I: Townsend, R. L., J. R. Skalski, and D. Yasuda. 1997. Evaluation of the 1995 predictions of run-timing of wild migrant subyearling chinook in the Snake River Basin using program RealTime. Technical Report (DOE/BP-35885-11) to BPA, Project 91-051-00, Contract 91-BI-91572.

Volume II: Townsend, R. L., J. R. Skalski, and D. Yasuda. 1998. Evaluation of the 1996 predictions of run-timing of wild migrant subyearling chinook in the Snake River Basin using program RealTime. Technical Report (DOE/BP-91572-2) to BPA, Project 91-051-00, Contract 91-BI-91572.

Volume III: Townsend, R. L., J. R. Skalski, and D. Yasuda. 2000. Evaluation of the 1997 predictions of run-timing of wild migrant yearling and subyearling chinook and sockeye in the Snake River Basin using program RealTime. Technical Report to BPA, Project 91-051-00, Contract 91-BI-91572.

Volume IV: Burgess, C., R. L. Townsend, J.R. Skalski, and D. Yasuda. 2000. Evaluation of the 1998 predictions of the run-timing of wild migrant yearling and subyearling chinook and steelhead, and hatchery sockeye in the Snake River Basin using program RealTime. Technical Report to BPA, Project 91-051-00, Contract 96BI-91572.

Volume V: Burgess, C., J.R. Skalski. 2000. Evaluation of the 1999 predictions of the run-timing of wild migrant yearling and subyearling chinook salmon and steelhead trout, and hatchery sockeye salmon in the Snake River Basin using program RealTime. Technical Report to BPA, Project 91-051-00, Contract 96BI-91572.

Volume VI: Burgess, C., J.R. Skalski. 2000. Evaluation of the 2000 predictions of the run-timing of wild migrant chinook salmon and steelhead trout, and hatchery sockeye salmon in the Snake River Basin, and combined wild and hatchery salmonids migrating to Rock Island and McNary Dams using program RealTime. Technical Report to BPA, Project 91-051-00, Contract 96BI-91572.

Volume VII: Skalski, J.R. and R.F. Ngouenet. 2001. Evaluation of the Compliance Testing Framework for RPA Improvement as Stated in the 2000 Federal Columbia River Power System (FCRPS) Biological Opinion. Technical Report to BPA, Project 91-051-00, Contract 96BI-91572.

Volume VIII: Skalski, J.R. and R.F. Ngouenet. 2001. Comparison of the RPA testing rules provided in the 2000 Federal Columbia River Power System (FCRPS) Biological Opinion with new test criteria designed to improve the statistical power of the biological assessments. Technical Report to BPA, Project 91-051-00, Contract 96BI-91572.

Volume IX: Burgess, C., J.R. Skalski. 2001. Evaluation of the 2001 Predictions of the Run-Timing of Wild and Hatchery-Reared Migrant Salmon and Steelhead Trout migrating to Lower Granite, Rock Island, McNary, and John Day Dams using Program Real-Time. Technical Report to BPA, Project 91-051-00, Contract 96BI-91572.

Volume X: Burgess, C., J.R. Skalski. 2002. Evaluation of the 2002 Predictions of the Run-Timing of Wild and Hatchery-Reared Migrant Salmon and Steelhead Trout migrating to Lower Granite, Rock Island, McNary, and John Day Dams using Program Real-Time. Technical Report to BPA, Project 91-051-00, Contract 96BI-91572.

Volume XI: Burgess, C., J.R. Skalski. 2004. Evaluation of the 2003 Predictions of the Run-Timing of Wild and Hatchery-Reared Migrant Salmon and Steelhead Trout migrating to Lower Granite, Rock Island, McNary, and John Day Dams using Program Real-Time. Technical Report to BPA, Project 91-051-00, Contract 00004134.

Other Publications Related to this Series

Other related publications, reports and papers available through the professional literature or from the Bonneville Power Administration (BPA) Public Information Center - CKPS-1, P.O. Box 3621, Portland, OR 97208.

1997

Townsend, R. L., D. Yasuda, and J. R. Skalski. 1997. Evaluation of the 1996 predictions of run timing of wild migrant spring/summer yearling chinook in the Snake River Basin using program RealTime. Technical Report (DOE/BP-91572-1) to BPA, Project 91-051-00, Contract 91-BI-91572.

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Townsend, R. L., P. Westhagen, D. Yasuda, J. R. Skalski, and K. Ryding. 1996. Evaluation of the 1995 predictions of run timing of wild migrant spring/summer yearling chinook in the Snake River Basin using program RealTime. Technical Report (DOE/BP-35885-9) to BPA, Project 91-051-00, Contract 87-BI-35885.

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Townsend, R. L., P. Westhagen, D. Yasuda, and J. R. Skalski. 1995. Evaluation of the 1994 predictions of the run-timing of wild migrant yearling chinook in the Snake River Basin. Technical Report (DOE/BP-35885-8) to BPA, Project 91-051-00, Contract 87-BI-35885.

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Skalski, J. R., G. Tartakovsky, S. G. Smith, P. Westhagen, and A. E. Giorgi. 1994. Pre-1994 season projection of run-timing capabilities using PIT-tag databases. Technical Report (DOE/BP-35885-7) to BPA, Project 91-051-00, Contract 87-BI-35885.

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Skalski, J. R., and A. E. Giorgi. 1993. A plan for estimating smolt travel time and survival in the Snake and Columbia Rivers. Technical Report (DOE/BP-35885-3) to PA, Project 91-051-00, Contract 87-BI-35885.

Smith, S. G., J. R. Skalski, and A. E. Giorgi. 1993. Statistical evaluation of travel time estimation based on data from freeze-branded chinook salmon on the Snake River, 1982-1990. Technical Report (DOE/BP-35885-4) to BPA, Project 91-051-00, Contract 87-BI-35885.

Preface

Project 91-051 was initiated in response to the Endangered Species Act (ESA) and the subsequent 1994 Council Fish and Wildlife Program (FWP) call for regional analytical methods for monitoring and evaluation. This project supports the need to have the "best available" scientific information accessible to the BPA, fisheries community, decision-makers, and public by analyzing historical tagging data to investigate smolt outmigration dynamics, salmonid life histories and productivity, and providing real-time analysis to monitor outmigration timing for use in water management and fish operations of the hydrosystem. Primary objectives and management implications of this project include: (1) to address the need for further synthesis of historical tagging and other biological information to improve understanding and identify future research and analysis needs; (2) to assist in the development of improved monitoring capabilities, statistical methodologies and software tools to aid management in optimizing operational and fish passage strategies to maximize the protection and survival of listed threatened and endangered Snake River salmon populations and other listed and non-listed stocks in the Columbia River Basin; (3) to develop better analysis tools for monitoring evaluation programs; and (4) to provide statistical support to the Bonneville Power Administration and the Northwest fisheries community.

The following report addresses measure 4.3C of the 1994 Northwest Power Planning Council's Fish and Wildlife Program with emphasis on improved monitoring and evaluation of smolt migration in the Columbia River Basin. This report represents the fourteenth in a series of technical reports presenting results of applications of statistical program RealTime to present inseason predictions of the status of smolt migrations in the Columbia River Basin. Results and evaluation of program RealTime 2004 predictions of the run-timing of wild and hatchery-reared salmon and steelhead trout to Lower Granite, Rock Island, McNary, John Day, and Bonneville Dams are presented. It is hoped that making these real-time predictions and supporting data available on the Internet for use by the Technical Management Team (TMT) and members of the fisheries community will contribute to effective in-season population monitoring and assist in-season management of river and fisheries resources. Having the capability to more accurately predict smolt outmigration status improves the ability to match flow augmentation to the migration timing of ESA listed and other salmonid stocks and also contributes to the regional goal of increasing juvenile passage survival through the Columbia River system.

Abstract

Program RealTime provided monitoring and forecasting of the 2004 inseason outmigrations via the internet for 31 PIT-tagged stocks of wild ESU chinook salmon and steelhead to Lower Granite and/or McNary dams, one PIT-tagged hatchery-reared ESU of sockeye salmon to Lower Granite Dam, and 20 passage-indexed runs-at-large, five each to Rock Island, McNary, John Day, and Bonneville Dams. Twenty-one stocks are of wild yearling chinook salmon which were captured, PIT-tagged, and released at sites above Lower Granite Dam in 2003, and have at least one year's historical migration data previous to the 2004 migration. These stocks originate in drainages of the Salmon, Grande Ronde and Clearwater Rivers, all tributaries to the Snake River, and are subsequently detected through the tag identification and monitored at Lower Granite Dam.

In addition, seven wild PIT-tagged runs-at-large of Snake or Upper Columbia River ESU salmon and steelhead were monitored at McNary Dam. Three wild PIT-tagged runs-at-large were monitored at Lower Granite Dam, consisting of the yearling and subyearling chinook salmon and the steelhead trout runs. The hatchery-reared PIT-tagged sockeye salmon stock from Redfish Lake was monitored outmigrating through Lower Granite Dam. Passage-indexed stocks (stocks monitored by FPC passage indices) included combined wild and hatchery runs-at-large of subyearling and yearling chinook, coho, and sockeye salmon, and steelhead trout forecasted to Rock Island, McNary, John Day, and Bonneville Dams.

Executive Summary

2004 Objectives

1. Apply program RealTime to provide in-season predictions of the run-timing of Fish Passage Center (FPC) passage-index counts of runs-at-large of subyearling and yearling chinook salmon, sockeye salmon, coho salmon and steelhead trout to Rock Island, McNary, John Day, and Bonneville Dams (20 stocks total) and to provide in-season predictions of the run-timing of PIT-tagged stocks to Lower Granite and McNary Dams (33 runs total). The PIT-tagged stocks include 10 wild runs-at-large of yearling and subyearling chinook salmon, sockeye salmon and steelhead trout, 22 wild release/recovery stocks of yearling and subyearling chinook salmon, and 1 hatchery-reared stocks of sockeye salmon from the Salmon River drainage. Specific tasks were to predict and report in real-time the "percent run-to-date" and "date to specified percentiles" of the outmigrations to the dams.

2. Post on-line predictions on outmigration status and trends in order to improve in-season population monitoring information available for use by the Technical Management Team and the fisheries community to assist river management.

Accomplishments

Runs-at-large of FPC passage indices of combined hatchery and wild salmon and steelhead were monitored and forecasted by Program RealTime in 2004 to Rock Island, McNary, John Day, and Bonneville Dams. Runs-at-large of wild PIT-tagged salmon and steelhead were monitored and forecasted by Program RealTime in 2004 to Lower Granite and McNary Dams. These runs included Snake River steelhead trout, Upper Columbia steelhead trout, the composite of these two steelhead runs, Snake River yearling chinook salmon, Snake River sockeye salmon, Snake River subyearling chinook salmon, and Upper Columbia River subyearling chinook salmon. The release/recovery stocks of wild PIT-tagged yearling chinook salmon tracked to Lower Granite Dam included Bear Valley Creek, Big Creek, Camas Creek, Cape Horn Creek, Catherine Creek, Chamberlain Creek--West Fork, Elk Creek, Herd Creek, Imnaha River, Lake Creek, Lemhi River, Lolo Creek, Lookingglass Creek, Loon Creek, Lostine River, Marsh Creek, Minam River, South Fork Salmon River, Secesh River, Sulfur Creek and Valley Creek (21 total). The release/recovery stock of wild PIT-tagged subyearling chinook salmon tracked to Lower Granite Dam is a stock marked and released by William Connor (Dvorshak Fish Complex) between river kilometers 224 and 268 on the mainstem Snake River. The release/recovery stock of hatchery-reared PIT-tagged sockeye salmon tracked to Lower Granite Dam was Redfish Lake.

Since 1999, unmarked hatchery salmon have been released into the Snake River. To provide run-timing information on wild runs-at-large since then, the RealTime forecasting project has monitored and forecasted wild, PIT-tagged subpopulations of salmon and steelhead to Lower Granite Dam, and beginning in 2001, to McNary Dam.

On-line run-timing predictions were provided via the Internet at *www.cbr.washington.edu/crisprt* to the fisheries community throughout each smolt outmigration. The types of graphical displays available for each stock in the RealTime project are included throughout this report. Also available (and included in the appendices to this report) are detailed tabular displays of historical run-timing information and expected rates of detection for each stock (Appendix B).

Findings

Program RealTime performance is evaluated using MADs (*mean absolute differences*, the average of the absolute difference between predicted and true passage percentiles), calculated for the first and last halves of the outmigration, and for the season-wide outmigration.

The run-at-large of wild PIT-tagged Snake River yearling chinook salmon smolts monitored at McNary Dam was predicted very well in 2004, with a season-wide MAD of 1.5%. Program RealTime predictions for the run-at-large of wild PIT-tagged yearling chinook salmon from the Snake River drainage outmigrating to Lower Granite Dam were comparable to the previous years (MAD = 5.2%). Stocks from release sites that were monitored individually by Program RealTime in 2004 were predicted fairly well based on the composite run (season-wide MAD = 2.6%) and on the average (mean MAD over all stocks for the entire season was 7.3%, up from 10.0% in 2003). Only 4 of 21 stocks had season-wide MADs larger than 10%. These larger prediction errors are mostly due to earlier, quicker migrations this year for those stocks.

RealTime predictions of the run-timing of wild PIT-tagged Snake River steelhead trout to Lower Granite and McNary Dams improved this year (season-wide MADs less than 4.5% at both dams compared to greater than 7% last year). The numbers of Upper Columbia River steelhead trout outmigrating to McNary Dam were far above expected, however this run was fairly well-predicted this year (season-wide MAD was 6.7% compared to 7.0% in 2003).

The run of wild PIT-tagged Snake River sockeye salmon monitored and forecasted at McNary Dam continued to worsen (season-wide MAD = 24.5% versus 11.3% last year). This stock saw very low counts at McNary Dam (45 compared to an historical average of 274). The season-wide MAD for PIT-tagged hatchery sockeye salmon from the Redfish Lake was 7.8%, comparable to last year (6.7%).

The forecasting of wild PIT-tagged Snake River subyearling fall chinook passage at Lower Granite Dam was not quite as good as last year, but still quite respectable (season-wide MAD = 5.3% versus last year's 2.8%). The run of wild PIT-tagged Upper Columbia and Snake River subyearling fall chinook salmon monitored at McNary Dam each had season-wide MADs = 7.2%.

The results of program RealTime in forecasting run-timing and passage percentiles of FPC passage-indexed runs-at-large to Rock Island, McNary, John Day, and (added this year) Bonneville Dams were excellent this year. In particular, 3 of 20 stocks had season-wide MADs above 7%, 13 of the remaining had MADs less than 4%, 8 less than 3%, and 4 had season-wide MADs within 2% of the true end-of season distribution.

Management Implications

The ability to accurately predict the outmigration status of composite or individual salmon and steelhead stocks at different locations in the Federal Columbia River Power System (FCRPS) can provide valuable information to assist water managers. Since the 1994 outmigration, program RealTime has been applied to provide in-season predictions of smolt outmigration timing for individual and aggregates of listed threatened and endangered Snake River salmon stocks, and, since 2000, of listed Mid-Columbia River stocks. These predictions have been made publicly available to the fisheries community to assist in-season river management in real time throughout the course of the smolt outmigration.

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Acknowledgments

We wish to express thanks to the many fisheries agencies, Tribes and other institutions that have expended considerable resources in the generation, assembly, analysis and sharing of Columbia River biological, hydrologic, operational and other related information. Deserving particular thanks are the staff of the agencies and Tribes responsible for conducting the annual Columbia River Smolt Monitoring Program, the Fish Passage Center, and the Pacific States Marine Fisheries Commission PIT-Tag Information System (PTAGIS), primary database centers for providing timely in-season access to fish passage and PIT-tag information; and the University of Washington second-tier database DART (Data Access in Real Time) information system which receives, processes and provides access to biological, hydrologic and operational information via the Internet.

Appreciation is extended to Chris Van Holmes, Susannah Iltis and Peter Westhagen of the School of Aquatic & Fishery Sciences at the University of Washington for providing critical technical, data management and computer programming support.

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1.0 Introduction

Regulating the timing and volume of water released from storage reservoirs (often referred to as flow augmentation) has become a central mitigation strategy for improving downstream migration conditions for juvenile salmonids in the Columbia River Basin. Snake River and Upper Columbia River water managers have used flow augmentation to improve the outmigration survival of stocks listed as threatened or endangered under the Endangered Species Act (ESA). Timing the release of water so that the listed stocks are in place to encounter these augmented flows requires knowledge of the status and trend of the stocks' outmigration timing.

In 1993, work was begun under this project to develop real-time predictions of smolt outmigration dynamics for ESA-listed stocks from the Snake and Columbia Rivers. Program RealTime was developed as a statistical software program which predicts run-timing of individual stocks of salmonids (Skalski et al. 1994). It uses historical data to predict the percentage of the outmigration that will reach an index site, in real-time; and it forecasts the elapsed time until some future percentage is observed at that site. The first in-season predictions were of wild spring/summer chinook salmon smolts from the Snake River drainage above Lower Granite Dam during the 1994 outmigration. These fish originate in streams listed by the National Marine Fisheries Service (NMFS) as evolutionarily/ecologically significant units (ESUs). As parr, a portion of these fish are annually implanted with passive integrated transponder (PIT, Prentice et al., 1990a, b, c) tags, and released back into their natal streams (Achord et al., 1994, 1995, 1996, 1997, 1998, 2000) where they over-winter until their outmigration as yearlings in the spring and summer. During outmigration, PIT-tag detectors at Lower Granite Dam read the tag codes so individual stocks can be monitored.

University of Washington fisheries scientists subsequently incorporated Program RealTime predictions into their CRiSP model to move the forecasted runs of these stocks down the Snake and Columbia Rivers to McNary Dam (e.g., Hayes et al. 1996, Beer et al. 1999, *http://*www.cqs.washington.edu/crisprt).

Since 1994, the RealTime forecasting project has expanded its scope to monitor and forecast other NMFS-listed populations of Columbia River Basin salmonids. In 1997 Program RealTime began forecasting the run-timing of hatchery-reared PIT-tagged summer-run sockeye salmon released into remote lakes and streams in Idaho over 700 kilometers upriver from Lower Granite Dam. *Release-recovery* data was used for the first migration forecasts by RealTime, and beginning the 1997 migration year, Program RealTime was adapted to utilize *index-count* data such as Fish Passage Center (FPC) passage indices (e.g., FPC, 1999). The distinction between these two types of data is important for understanding how RealTime makes initial predictions early in the season, and are described in detail in the models section (Section 2.4.1). Release-recovery counts consist only of those detections of fish that are identified as part of a

specific release group, i.e. fish with PIT-tags identifying their release to a specific time or place (or both). By contrast, index-count stock data consist of all detections at the dam of a particular species, regardless of their release details, i.e. regardless of when or where they were released. Index-count stocks using FPC passage indices were included in the RealTime project to provide run-timing forecasts for wild runs-at-large of yearling and subyearling chinook salmon and steelhead trout to Lower Granite Dam. These runs were predicted with considerable accuracy (Townsend et al. 1998, Burgess et al. 1999) but were discontinued in 1999 and 2000 when hatcheries ceased their practice of marking their fish to distinguish them from wild fish (Burgess et al., 1999). To continue providing run-timing information on wild Snake River runs-at-large of yearling and subyearling chinook salmon and steelhead trout, the RealTime project began to monitor PIT-tagged wild fish. The first such stock was a release-recovery stock of wild subyearling fall chinook tagged for doctoral research by William Connor (Burgess et al., 1999), a subpopulation whose run-timing characteristics were believed to mimic those of the larger wild population. In 2000, RealTime began monitoring two wild index-count stocks of PIT-tagged salmon and wild steelhead trout at Lower Granite Dam, and in 2001, seven new such stocks were monitored at McNary Dam, including runs from the Upper Columbia River as well as the Snake River, reflecting concern about water management during a predicted drought year (Burgess and Skalski, 2001).

While releasing unmarked hatchery fish into the Snake River spelled the demise of the Real-Time project's capability of monitoring wild runs-at-large to Lower Granite (because hatchery releases swamp the signature passage patterns of wild fish), the same is not true for all Columbia River Basin dams. In 2000, the RealTime project began monitoring and forecasting runs-at-large of combined hatchery and wild salmon and steelhead to Rock Island Dam on the upper Columbia River and to McNary Dam on the mainstem Columbia. For these forecasts, Program RealTime used FPC passage indices. In 2001, out of concern about passage status in a low flow year, the run-at-large of combined wild and hatchery subyearling fall chinook salmon was monitored and forecasted to John Day Dam on the Columbia River, using FPC passage indices (Burgess and Skalski, 2001). In 2002, we expanded RealTime's John Day forecasting to include all species of salmonid, and added Bonneville Dam in 2004.

This report presents a post-season analysis of Program RealTime performance for 2004. RealTime predictions are compared with end-of-season observed distributions of passage indices or PIT-tag detections at Lower Granite, Rock Island, McNary, John Day, and Bonneville Dams. During the outmigration season, predictions were accessible daily, via the World Wide Web at address *http://www.cqs.washington.edu/crisprt.* The website's end-of-season graphical and tabular displays of Program RealTime results, by stock, are included in Appendices A through D. Appendix A contains the daily record of RealTime predictions compared with the end-of-season observed distributions for all runs monitored by Program RealTime in 2004. Appendix B contains graphical and tabular displays of historical run-timing characteristics, including the dates of the first and last detections of the season, and dates of the

5th, 10th, 50th, 90th and 95th percentiles of passage, the middle 80% passage period (in days), the total numbers of fish counted inseason annually, and for the release-recovery stocks, the expected number of annual detections. Appendix C contains records of daily flow, spill and spill-adjustment parameters (Section 2.4). Appendix D displays the record of RealTime performance since 1995 of all stocks included in the 2004 project.

2.0 Methods

2.1 Description of Data

2.1.1 *PIT-tagged Stocks*

PIT-tag data are made available by the Pacific States Marine Fisheries Commission's PIT Tag Information System (PTAGIS) project. In 2004, the outmigration status was monitored and forecasted at Lower Granite Dam for 22 release sites of wild PIT-tagged subyearling and yearling chinook salmon and one release site of hatchery sockeye salmon. In addition, a number of composites of Snake River and Upper Columbia River release sites for steelhead trout, yearling chinook, sockeye, and subyearling chinook salmon were monitored at both Lower Granite and McNary Dams.

Release-recovery Stocks

The RealTime project provided run-timing information on 23 release-recovery stocks, all monitored at Lower Granite Dam. These were 1) 21 stocks of wild spring/summer yearling chinook salmon captured, tagged and released into streams above Lower Granite during the spring, summer and fall of 2003, 2) a population of wild subyearling fall chinook salmon PIT-tagged by William Connor and released into the Snake River near its confluence with the Salmon River, and 3) one hatchery-reared, summer-run sockeye salmon stocks outmigrating from Redfish Lake in Idaho. Table 2.1 displays the U.S. Geological Survey hydro-unit numbers for these release sites, and Figure 2.1 shows the locations of the 23 sites from which wild smolts were sampled, PIT-tagged and released.

Release-recovery stocks originating from tag/release sites have additional filters on the data that index-count stocks do not. Originally, tag/release sites were chosen on the basis of their consistent recovery numbers (PIT-detections at LGR)[1], and by virtue of having at least three years of historical data, each with at least 30 PIT-tag detections. Finally, detections of fish tagged May 31 - November 1 of the previous year are used, as fish marked later may have different migrational timing characteristics (Keefe et al. 1995, 1996). Over the years, stocks with less historical information were added, as it was found that the program was able to provide good predictions for these as well. From 1998 through 2001, only stocks PIT-tagged by experienced taggers Steve Achord or Paul Sankovitch were included in the project. This criterion was dropped for the 2002 RealTime Project as these taggers did not tag fish in the summer and fall of 2001.

[1] Detections of PIT-tagged smolts at Lower Granite Dam are seen as recaptures or recoveries in a tag-release-recapture experiment, so the terms "recapture", "recovery", and "detection" may be used interchangeably.

Since 2003, only the seasonal criteria were kept in place.

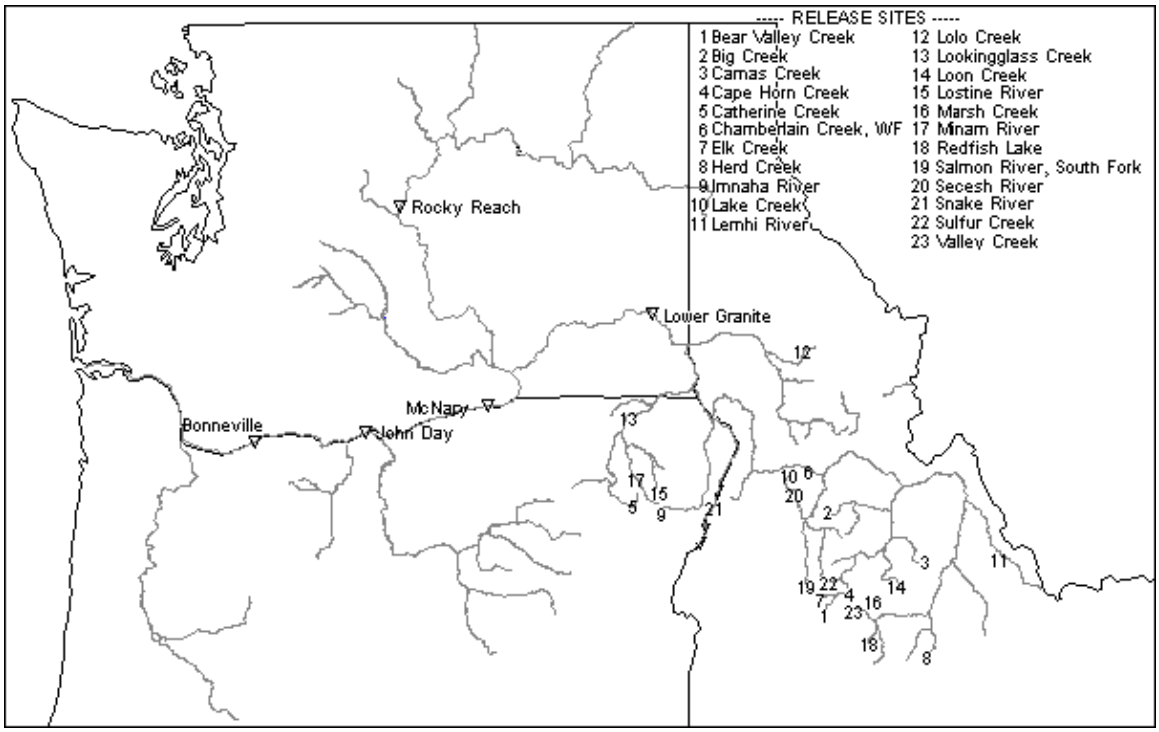
In addition, a number of "composite runs" (combined data from several streams treated as a single stock) were forecasted at Lower Granite Dam. Composite runs tend to produce good predictions, as the larger number of fish in the combined group smooth and dampen the randomness observed in individual stock release groups. They can be useful for providing general run-timing information for broad geographical regions. Two composites were created for yearling chinook salmon. The CRiSP/RealTime composite includes only release sites that meet the stringent data requirements of the CRiSP model: Catherine Creek, Imnaha River, Minam River, and South Fork Salmon River. The RealTime Composite consists of all the individual release sites of yearling chinook used in Program RealTime (Table 2.1).

Table 2.1: The GIS hydro-units of the 21 PIT-tag/release sites for spring/summer yearling chinook salmon, the single PIT-tag/release site for fall subyearling chinook salmon, and one PIT-tag release site for sockeye salmon. These are all release sites for the 23 release-recovery stocks included in the 2003 Program RealTime forecasting project, monitored at Lower Granite Dam.

Release Site					GIS[2]
Abbreviation	Long Name	Rearing	Run	Species	Hydrounit
BEARVC	Bear Valley Creek	W	Sp/Su	Chinook	17060205
BIGC	Big Creek	W	Sp/Su	Chinook	17060206
CAMASC	Camas Creek	W	Sp/Su	Chinook	17060206
CAPEHC	Cape Horn Creek	W	Sp/Su	Chinook	17060205
CATHEC	Catherine Creek	W	Sp/Su	Chinook	17060104
CHAMWF	West Fork Chamberlain Creek	W	Sp/Su	Chinook	17060207
ELKC	Elk Creek	W	Sp/Su	Chinook	17060205
HERDC	Herd Creek	W	Sp/Su	Chinook	17060201
IMNAHR	Imnaha River	W	Sp/Su	Chinook	17060102
LAKEC	Lake Creek	W	Sp/Su	Chinook	17060208
LEMHIR	Lemhi River	W	Sp/Su	Chinook	17060204
LOLOC	Lolo Creek	W	Sp/Su	Chinook	17060306
LOOKGC	Lookingglass Creek	W	Sp/Su	Chinook	17060104
LOONC	Loon Creek	W	Sp/Su	Chinook	17060205
LOSTIR	Lostine River	W	Sp/Su	Chinook	17060105
MARSHC	Marsh Creek	W	Sp/Su	Chinook	17060205
MINAMR	Minam River	W	Sp/Su	Chinook	17060106
REDFL	Redfish Lake	H	Su	Sockeye	17060201
SALRSF	Salmon River, South Fork	W	Sp/Su	Chinook	17060208
SECESR	Secesh River	W	Sp/Su	Chinook	17060208
SNAKER	Snake River (RK 224 to 268)	W	Fall	Chinook	17060110
SULFUC	Sulfur Creek	W	Sp/Su	Chinook	17060205
VALEYC	Valley Creek	W	Sp/Su	Chinook	17060201

[2] Geographical Information System (GIS) designations established by the U.S. Geological Survey.

Figure 2.1: Map showing release sites for the 23 release-recovery stocks (Table 2.1) monitored by Program RealTime in 2004 to Lower Granite Dam.



PIT-tagged wild fall subyearling chinook salmon were monitored at Lower Granite and McNary Dams to provide run-timing information about the wild run-at-large of Snake River fall subyearling chinook salmon, as FPC passage indices for the wild run were unavailable after June 6, 1999 (Burgess et al., 1999). Since 1993, subyearling fall chinook salmon smolts have been sampled, PIT-tagged and released into the Snake River between river kilometers 224 and 268. These smolts are tagged and released at regular intervals, from April into July or until water temperatures approach 20°C or catch counts near zero. They begin to appear in the detection facility at Lower Granite Dam around June 1 and continue through September or October. This subpopulation mimics passage of the run-at-large well during the first and middle portions of the run[3].

One release-recovery stock of sockeye salmon was included in 2004. The hatchery-reared summer-run sockeye salmon from Redfish Lake was monitored at Lower Granite Dam.

Index-Count Stocks

Composite stocks of run-at-large groups pose a challenge in estimating the outmigration status at a

[3] Historical comparisons from 1993 to 1998, of the passage distributions of the run-at-large with the PIT-tagged subpopulation are available on the internet at *www.cbr.washington.edu/crisprt/info.html.*

dam. While analyses of individual releases could provide a historical percentage of the release size observed at a dam, these individual releases are usually quite small and variable. In addition, release sizes change annually, further mudding the contribution each group adds to the expected number of total fish to be observed at a dam. Instead of focusing on the total number of fish released, index-count stocks estimate the status of the outmigration upon the number of fish observed at a dam compared to the total expected to be observed, based on historical counts. For example, a release-recapture stock may have ten percent of the total released historically appear at Lower Granite Dam, so of 1000 fish released this year, we would expect that 100 fish total will show up. For an index-count stock, we don't know what percent of the fish released has been observed historically, but do know that on average, 100 total fish have been counted, and so expect the same again this year.

Two run-at-large composites were created for a number of species. Each composite consists of PIT-tagged wild fish released in either the Snake River drainage or the Upper Columbia River. Table 2.2 lists which species run-at-large composites were monitored at Lower Granite and McNary Dams.

Table 2.2: Migration status at Lower Granite and McNary Dams was monitored and forecasted for the indicated PIT-tagged, wild species released in the Snake River drainage, Upper Columbia River, or combination of the two. An "X" indicates that that group was included in 2004.

		Detection Site	
Species	Composite run-at-large	Lower Granite Dam	McNary Dam
Yearling chinook salmon	Snake River	X	X
Steelhead trout	Snake River	X	X
	Upper Columbia River		X
	Combined		X
Sockeye salmon	Snake River		X
Subyearling chinook salmon	Snake River[4]		X
	Upper Columbia River		X

2.1.2 *Fish Passage Center (FPC) Passage-Indexed Stocks*

Passage index data were made available by the Northwest Power Planning Council's (NWPPC) Fish Passage Center (FPC). Passage indices are sample counts in the bypass system at the dam divided by the proportion of water passing through the sampling system. They are collected according to FPC sampling plans (e.g., Fish Passage Center, 1999), and are intended to reflect the size of the run. All FPC

[4] The subyearling chinook run-at-large composite migration forecasts at Lower Granite Dam use fish PIT-tagged and released into the Snake River between river kilometers 224 and 268, and are not an *index-count* stock.

passage-indexed stocks are index-count stock. Timing characteristics of these runs of mid-Columbia and mainstem Columbia River yearling and subyearling chinook salmon, coho and sockeye salmon and steelhead trout runs were monitored and forecasted to Rock Island, McNary, John Day and Bonneville Dams. The migration status can be very accurately predicted, provided large hatchery releases do not overwhelm the normal signature pattern of fish passage run-timing (Burgess and Skalski, 2000).

2.2 Preprocessing of Data

Raw PIT-tag detections are adjusted for spill fraction (Section 2.3) and smoothed using three 5-day smoothing passes to filter out statistical randomness before input to the RealTime forecaster algorithm. Raw passage index data are smoothed the same as PIT-data.

2.3 Adjustment of Raw Smolt Counts for Spill or Flow.

2.3.1 *PIT-tagged Stocks*

PIT-tagged stocks are detected at a dam by passing through a PIT-tag interrogation system, usually set up in bypass routes. However, this is not the only route past a dam--fish that pass through the spillway are not detected, so formulas are devised to upwardly adjust the raw counts of PIT-detections. Ti get an estimate of the total fish passing through a dam on a particular day. Daily numbers of fish detected, "raw counts", are multiplied by an expansion factor, resulting in "adjusted counts" according to the formula

raw counts x expansion factor = adjusted counts.

The expansion factor is $$\frac{1}{1-SE}, \tag{2.1}$$

where *SE* is *spill effectiveness*, the fraction of smolts passing through the spillway (NMFS, 2000). Different formulations for *SE* are required for different species of salmonids (Skalski and Perez-Comas 1998) and for different dam configurations (NMFS, 2000). The formula for spill effectiveness for chinook and sockeye salmon at Lower Granite Dam is given by Smith et al. (1993) as

$$SE_{chinook\_sockeye} = 1.667\left(\frac{S}{F}\right)^3 - 3.25\left(\frac{S}{F}\right)^2 + 2.583\left(\frac{S}{F}\right) \tag{2.2a}$$

(Figure 2.2, red), and the formula for steelhead is given by Skalski and Perez-Comas (1998) as

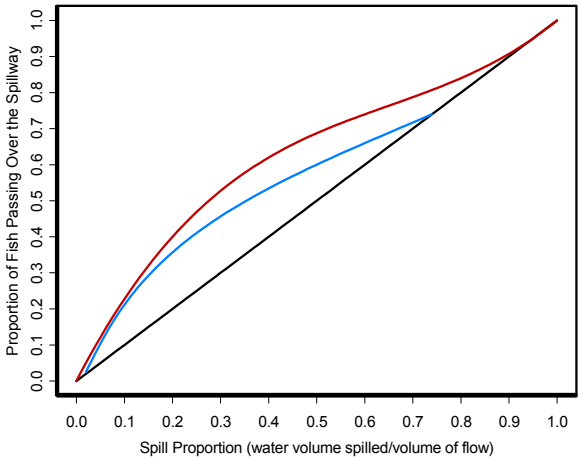
$$SE_{steelhead} = 0.6001^{\exp\left(-0.5063-\log\left(\frac{S/F}{1-S/F}\right)\right)}. \tag{2.2b}$$

In the figure, *S* is the daily volume of water spilled and *F* is daily outflow volume. For 2004, the formulation of *SE* as a function of spill proportion at McNary Dam was a one-to-one function (NMFS, 2000) of *SE* to spill proportion (i.e. the volume of water spilled divided by volume of outflow) (Figure 2.2,

black),

$$SE = \frac{S}{F} = \text{spill volume / flow volume = spill proportion.} \qquad (2.2c)$$

Figure 2.2: Spill effectiveness (SE) functions (equations 2.2a, b, c) used by Program Real-Time to upwardly adjust raw PIT-tag detections. Shown are the 2004 RealTime spill effectiveness curves as functions of spill proportion (S/F, the proportion of spill, S, relative to outflow, F) at Lower Granite Dam (red, blue) and at McNary Dam (black).



2.3.2 *FPC Passage-Indexed Stocks*

Raw passage index data are adjusted for the spill fraction by the Fish Passage Center.

2.4 The RealTime Forecaster

2.4.1 *Models and Algorithm*

The RealTime forecaster is essentially a pattern-matching algorithm. However, at the beginning of the outmigration there is very little in the way of a pattern to match. To optimize predictions for all phases of the outmigration, the forecaster utilizes three models: a start-up model for initial predictions, the pattern-matching model, and a switching model to govern the timing of the switch between the start-up and pattern-matching models.

The pattern-matching portion is accomplished by a least-squares (LS) model, where the patterns are cumulative percentage curves of outmigrating smolts. Current-year data are compared with historical cumulative percentage curves by comparing their slopes at each percentile, j = 1, …, 100, using the measure

$$\sum_j \left(s_j - s_{ijp} \right)^2, \qquad (2.3)$$

where s_j is the slope at the j^{th} percentile of current-year data to-date and s_{ijp} is slope at the j^{th} percentile of p percent of historical year i's outmigration. The value p of that minimizes (2.3), i.e.,

$$\min_{p}\left[\sum_{j=1}\left(s_j - s_{ijp}\right)^2\right], p = 0,...,100 \tag{2.4}$$

is the best predictor from the point of view of pattern-matching to historical year i.

The start-up model produces run-percentage (RP) estimates

$$p_{RP} = \frac{x_d}{\widehat{E(S)}}, \tag{2.5}$$

where x_d = total number of fish observed by day d of the outmigration, and

$\widehat{E(S)}$ = the total expected outmigration through the detection facility.

How the expected total migration is estimated depends on the type of data. For tagged stocks that have reliable annual release/recapture data (i.e., the 21 release-recovery stocks monitored at Lower Granite Dam, Section 2.1.1), $\widehat{E(S)} = \overline{r} \times N$, where $\overline{r}$ is the average annual historical recapture percentage[5] at the detection facility, and N is total number of fish released from a release site the previous year (for yearling chinook salmon) or earlier in the year (for subyearling chinook and sockeye salmon). Table 2.3 displays $N, \overline{r}$, and $\widehat{E(S)}$ for each release-recovery stock. For index-count data such as FPC passage indices and PIT-tagged aggregates (Section 2.1.1), $\widehat{E(S)}$ is the average number of historical detections. Table 2.4 displays expected observed counts for each index-count stock. The RP estimates (2.5), are more accurate than LS (pattern-matching) estimates (2.4) initially, but are quickly outperformed by LS model as the season progresses (Townsend et al., 1995, 1996, 1997).

The switching model is an age-of-run (AR) model based on mean fish-run-age (MFRA). This switching model weights the predictions from the LS and RP models differentially as the outmigration season progresses. Thus each model provides its unique estimate for the true passage percentile for the day, and the algorithm minimizes a complex formula weighting estimates from each model and their respective error calculations (see Burgess et al., 1998 for complete algorithm details). The forecaster effectively combines age-of-run (AR) and run percentage (RP) indicators together with the least-squares (LS) pattern-matching principle into a single, more accurate and robust predictor.

[5] Annual recapture percentage is the number of unique fish detected divided by the total number released.

Table 2.3: Data used by Program RealTime in 2004 to compute initial predictions (formula 2.5), for PIT-tagged release-recovery stocks of wild Snake River spring/summer yearling chinook salmon, hatchery sockeye salmon, and wild PIT-tagged Snake River subyearling fall chinook salmon[6]. The number of PIT-tagged parr released by site (*N*), the historical average of annual recapture percentage for each site ($\bar{r}$), and the expected number of detections for the 2004 migration year.

Tagging Location	# parr released (N)	Avg. Historical % ($\bar{r}$)	$\hat{E}(S)$
Bear Valley Creek	1494	11.7	174.43
Big Creek	2403	12.1	290.96
Camas Creek	1010	10.1	102.16
Cape Horn Creek	671	11.5	76.98
Catherine Creek	1340	11.9	159.61
West Fork Chamberlain Creek	753	7.4	55.65
Elk Creek	1520	12.7	192.94
Herd Creek	968	11.7	113.18
Imnaha River	998	11.5	114.37
Lake Creek	2668	10.5	280.39
Lemhi River	699	14.5	101.50
Lolo Creek	1570	14.3	225.00
Lookingglass Creek	289	13.9	40.18
Loon Creek	860	13.9	119.74
Lostine River	992	15.1	149.36
Marsh Creek	1534	9.7	148.79
Minam River	1397	13.9	194.40
Redfish Lake sockeye	1519	4.9	74.81
Salmon River, South Fork	1490	8.5	126.85
Secesh River	3068	11.2	345.29
Snake River (RK 224 to 268) wild subyearling chinook	5534	26.7	1479.72
Sulfur Creek	1049	9.5	99.76
Valley Creek	2498	6.3	157.75

[6] Data Sources: PTAGIS and FPC Smolt Index Databases and RealTime program output as of December 2004

Table 2.4: Data used by Program RealTime in 2004 to compute predictions (formula 2.5) for index-count stocks at the beginning of the migration. Average historical observed counts[7] of index-count stocks (runs-at-large) monitored and forecasted by RealTime in 2004 are used to predict current year expected numbers of counts, $\widehat{E(S)}$, (Section 2.4.1) using the run percentage (RP) model.

Rearing	Type of Data	Predicted Passage at	Stock	$\hat{E}(S)$
Wild	PIT-tag	Lower Granite Dam	Spring/Summer Yearling Chinook	11,314
			Steelhead Trout	7,151
		McNary Dam	Snake River Yearling Chinook Salmon	9,059
			Snake River Steelhead Trout	2,915
			Upper Columbia River Steelhead Trout	3,196
			Snake & Upper Columbia River Steelhead Trout	5,912
			Snake River Sockeye Salmon	274
			Snake River Subyearling Chinook Salmon	267
			Upper Columbia River Subyearling Chinook Salmon	1,584
Combined Wild & Hatchery	FPC Passage Indices	Rock Island Dam	Yearling Chinook Salmon	26,450
			Steelhead Trout	20,191
			Coho Salmon	42,717
			Sockeye Salmon	14,098
			Subyearling Chinook Salmon	18,131
		McNary Dam	Yearling Chinook Salmon	2,247,464
			Steelhead Trout	666,429
			Coho Salmon	274,437
			Sockeye Salmon	718,945
			Subyearling Chinook Salmon	7,849,257
		John Day Dam	Yearling Chinook Salmon	1,105,459
			Steelhead Trout	770,241
			Coho Salmon	335,953
			Sockeye Salmon	367,546
			Subyearling Chinook Salmon	1,837,433
		Bonneville Dam	Yearling Chinook Salmon	1,284,627
			Steelhead Trout	533,398
			Coho Salmon	1,048,294
			Sockeye Salmon	245,608
			Subyearling Chinook Salmon	1,558,220

[7] Data Sources: PTAGIS and FPC Smolt Index Databases and RealTime program output as of December 2004

2.4.2 *Precision of Estimator: Confidence Intervals for $\hat{P}$*

Each day of the run, a jackknife confidence interval is constructed for the daily prediction estimate, $\hat{P}$ (Section 2.4.1). Jackknifing is a computer-intensive method of extracting sampling distribution information about an estimator by recomputing the estimator from different subsets of the historical data. A jackknife subset consists of the complete set of historical years minus one year. If a release site has, say, six years of historical data, there will be 6 subsets of 5 years each. A prediction is estimated from each subset, and these jackknife predictions provide a measure of dispersion on which the daily confidence interval is based.

2.4.3 *Evaluating RealTime Performance*

The true outmigration percentile on day, P_d, can only be observed after the run is finished and all the fish that will be detected have passed (i.e., $P_{last} = 100\%$). When the run is over, we evaluate program RealTime's performance using the mean absolute difference (MAD) between observed outmigration percentiles, P_d, and their estimates, $\hat{P}_d$, for all days, *d*, until both predicted and observed runs are at 100%:

$$MAD = \frac{\sum_{d=1}^{n} \left| \hat{P}_d - P_d \right|}{d} \times 100\%$$

where *n* is the total number of days from the appearance of the first fish to the day where both the observed and predicted run has reached 100%. This is a slight change from previous years, but more accurately reflects those occasions where Program RealTime has continued to forecast less than 100% passage at a dam after the last fish has, in fact, been observed for the current migration season. Historical MADs presented in this report have been updated to reflect this change, and to give legitimate comparisons to past performance.

3.0 Results

3.1 Wild ESUs

3.1.1 *PIT-tagged Yearling Chinook Salmon*

Release-recovery Stocks Monitored at Lower Granite Dam

An overall indicator of Program RealTime forecasting performance for the 21 wild PIT-tagged yearling chinook salmon release-recovery stocks is the RealTime Select composite stock (Figure 3.1, see section 2.1.1 for definition). The RealTime Select Composite indicated continued improvement with a smaller season-wide MAD this year (2.56%) than last year (4.56%). Table 3.1 displays MADs for the yearling chinook salmon release/recovery stocks tracked at Lower Granite Dam, for the average MADs of all these stocks, and for the RealTime Select Composite stock. Fourteen of the 21 individual stocks also improved in prediction performance. Of the seven with larger MADs, four were very close to last year. The remaining three stocks (Bear Valley Creek, Cape Horn Creek, and Sulfur Creek) were predicted to have longer runs than actually occurred, resulting in consistently predicting that the migration progress was earlier than what it was in reality. It is notable in that almost all predicted stocks, except Lolo Creek, had less fish observed at Lower Granite Dam than the historical average (Table 3.2), but there was not degradation of RealTime's ability to forecast the migration status through the season.

Figure 3.1: Comparison of RealTime daily predictions of fish passage to Lower Granite Dam with the actual year-end distribution of the RealTime Composite run (Section 2.1.1), a composite of all 21 PIT-tagged spring/summer yearling chinook release-recovery stocks.

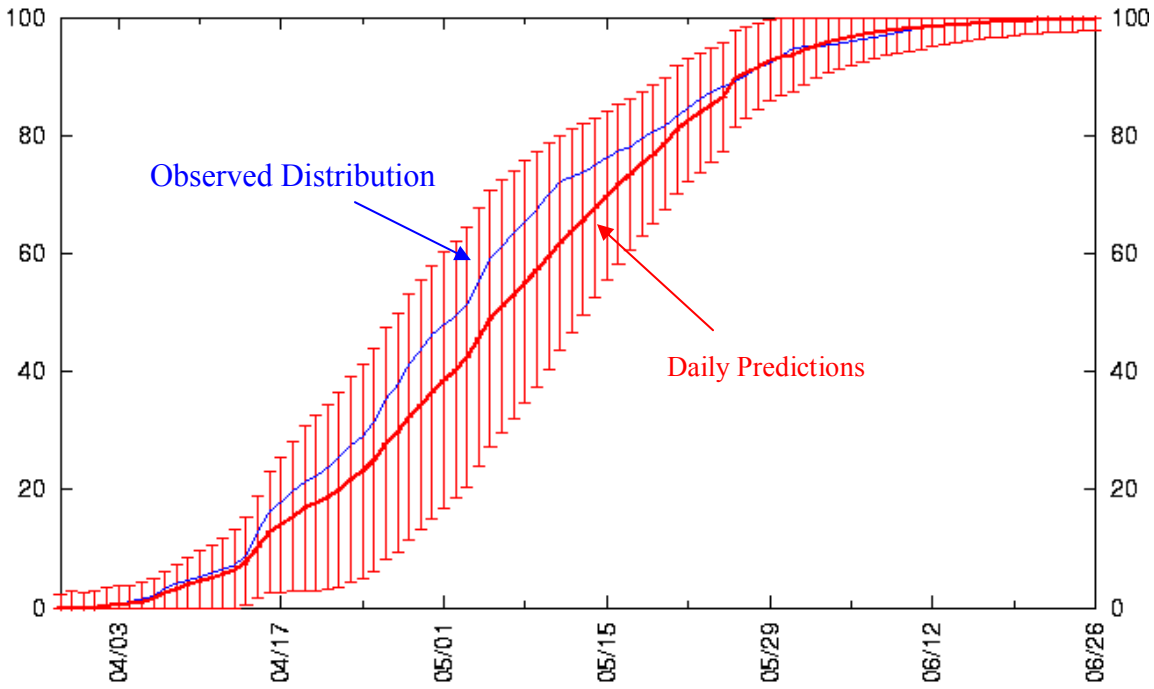


Table 3.1: Mean absolute differences (MADs, section 2.4.3) for the 2003 and 2004 outmigrations to Lower Granite Dam of 21 wild PIT-tagged Snake River spring/summer yearling chinook salmon ESUs and the RealTime Select Composite (section 2.1.1). Columns show MADs for the entire run, the first 50% of the run, and the last 50% of the run. All sites met the RealTime historical data criteria.

	2003			2004		
Stock	Entire Run	First 50%	Last 50%	Entire Run	First 50%	Last 50%
Bear Valley Creek	6.28	6.86	6.03	12.66	13.50	12.26
Big Creek	4.04	2.31	4.96	2.23	1.63	2.49
Camas Creek	10.29	9.43	10.90	4.10	2.86	4.89
Cape Horn Creek	4.09	3.20	5.10	19.67	14.55	22.37
Catherine Creek	3.88	3.27	4.53	5.90	2.77	8.94
West Fork Chamberlain Creek	11.92	9.48	13.25	5.14	1.39	6.30
Elk Creek	12.25	8.43	14.89	7.31	10.58	6.03
Herd Creek	7.02	2.20	11.09	1.45	1.56	1.41
Imnaha River	3.02	4.17	2.35	3.17	2.78	3.34
Lake Creek	13.04	21.21	7.73	3.22	5.67	2.41
Lemhi River	39.68	9.42	51.78	17.50	15.46	18.76
Lolo Creek	11.37	12.85	10.47	1.54	1.40	1.63
Lookingglass Creek	5.52	11.27	2.73	5.25	4.41	5.41
Loon Creek	7.28	6.00	8.32	3.95	1.59	5.39
Lostine River	5.38	1.44	8.10	5.76	2.95	8.72
Marsh Creek	7.53	4.94	9.34	5.98	4.00	7.07
Minam River	6.02	3.49	7.71	9.26	7.03	10.72
Salmon River, South Fork	23.79	23.44	24.07	2.98	3.50	2.72
Secesh River	17.89	13.24	19.59	3.34	5.85	2.60
Sulfur Creek	2.86	2.20	3.55	26.47	12.25	36.46
Valley Creek	5.98	2.92	10.38	5.52	2.55	8.41
Mean MAD	9.96	7.70	11.28	7.26	5.63	8.49
Select Composite Run	4.56	5.03	4.28	2.56	3.32	2.21

The mean first-half MAD over all 21 spring/summer chinook salmon release/recovery stocks was 5.6%, the mean last-half MAD was 8.5% and the mean season-wide MAD was 7.3%. These statistics are consistent with the corresponding 2003 MADs.

Table 3.2: Comparison of observed versus expected total (spill-adjusted) fish detected (Columns 1 and 2) at Lower Granite Dam for each release-recovery stock of yearling chinook salmon stocks monitored by Program RealTime in 2004, and comparison of observed versus historical average recapture percentages (Columns 3 and 4). Average recapture percentages are fundamental to making initial fish passage predictions (Sections 2.4). Most stocks showed smaller-than-average recapture percentages (fewer than expected fish) in 2004.

Tagging Location	Observed # Detections	Expected # Detections $\widehat{E(S)}$	Observed Recapture %	Average Historical % $\bar{r}$
Bear Valley Creek	70.6	174.43	4.7	11.7
Big Creek	245.3	290.96	10.2	12.1
Camas Creek	83.2	102.16	8.2	10.1
Cape Horn Creek	30.7	76.98	4.6	11.5
Catherine Creek	124.8	159.61	9.3	11.9
West Fork Chamberlain Creek	48.3	55.65	6.4	7.4
Elk Creek	96.5	192.94	6.4	12.7
Herd Creek	93.4	113.18	9.7	11.7
Imnaha River	90.5	114.37	9.1	11.5
Lake Creek	177.7	280.39	6.7	10.5
Lemhi River	41.1	101.50	5.9	14.5
Lolo Creek	229.1	225.00	14.6	14.3
Lookingglass Creek	28.3	40.18	9.8	13.9
Loon Creek	97.0	119.74	11.3	13.9
Lostine River	110.0	149.36	11.1	15.1
Marsh Creek	99.9	148.79	6.5	9.7
Minam River	100.0	194.40	7.2	13.9
Salmon River, South Fork	86.0	126.85	5.8	8.5
Secesh River	213.8	345.29	7.0	11.2
Sulfur Creek	31.4	99.76	3.0	9.5
Valley Creek	116.6	157.75	4.7	6.3

Index-Count Stocks Monitored at Lower Granite and McNary Dams

Similar to last year, although the individual release-recovery ESUs of wild Snake River yearling chinook salmon had smaller-than-average rates of detection, the wild PIT-tagged run-at-large of these fish to Lower Granite Dam had a larger rate of detection in 2003 than expected and the observed outmigration distribution was later than predicted (Appendix A). The MADs for this stock were around twice as large as last year (Table 3.3). This year's season-wide MAD was 5.2% compared to 4.7% last year. The run-at-large of wild PIT-tagged Snake River yearling chinook salmon monitored at McNary was very well-predicted, with a MAD of 1.5% vs. last year's season-wide MAD of 0.8%, with a MAD of 2.8%.

Table 3.3: Mean absolute deviations (MADs) for the 2003 and 2004 outmigration to Lower Granite and McNary Dams, of the PIT-tagged population of wild Snake River spring/summer yearling chinook salmon. Columns show MADs for the entire run, the first 50% of the run, and the last 50% of the run.

	2003			2004		
Detection Location	Entire Run	First 50%	Last 50%	Entire Run	First 50%	Last 50%
Lower Granite Dam	4.65	10.49	2.85	5.19	12.83	2.24
McNary Dam	2.79	3.69	2.49	1.52	3.53	1.17

3.1.2 *PIT-tagged Steelhead Trout*

The run-timing of wild PIT-tagged Snake River steelhead improved this year from last at both Lower Granite and McNary Dams. The season-wide MAD dropped from 7.2% to 3.6% at Lower Granite, and from 12.5% to 4.5% at McNary Dam. The PIT-tagged run-at-large of Upper Columbia wild steelhead at McNary Dam was predicted fairly well, and the season-wide MAD this year (6.7%) as last (7.0%). Both steelhead stocks saw approximately ten times the detections (Table 3.4) compared to the historical averages. This resulted in early predictions of the run being much further along than it was in reality. Should these large counts of detections continue, RealTime will adjust accordingly and continue to improve it forecasting in the first half of the season.

Table 3.4: Mean absolute deviations (MADs) for the 2002 and 2003 outmigrations of the PIT-tagged subpopulations of wild Snake and Upper Columbia Rivers steelhead detected at Lower Granite and McNary Dams. Columns show MADs for the entire run, the first 50% of the run, and the last 50% of the run.

	2003			2004		
Stock	Entire Run	First 50%	Last 50%	Entire Run	First 50%	Last 50%
Snake River steelhead detected at Lower Granite Dam	7.22	12.55	4.13	3.58	7.62	1.36
Snake River steelhead detected at McNary Dam	12.45	26.42	1.77	4.46	1.87	6.06
Upper Columbia River steelhead detected at McNary Dam	7.03	15.94	1.99	6.70	5.13	7.66
All wild steelhead detected at McNary Dam	9.50	17.98	2.07	5.72	6.66	5.12

3.1.3 *PIT-tagged Sockeye Salmon*

MADs for the wild PIT-tagged run-at-large of Snake River sockeye salmon smolts (an index stock) forecasted at McNary Dam were larger this year than last. The season-wide MAD was 24.5% compared to 11.3% last year (Table 3.5). Here, the opposite of the steelhead results occurred--after having a large turn out at McNary in 2003, the observed count of 45 sockeye is far below the expected detection count of 274. RealTime consistently under-predicted the status of the migration.

Table 3.5: Mean absolute deviations (MADs) for the 2003 and 2004 outmigrations to McNary Dam of the PIT-tagged population of wild Snake River sockeye salmon. Columns show MADs for the entire run, the first 50% of the run, and the last 50% of the run.

	2003			2004		
Detection Location	Entire Run	First 50%	Last 50%	Entire Run	First 50%	Last 50%
McNary Dam	11.28	9.55	11.88	24.47	15.57	30.78

3.1.4 *PIT-tagged Subyearling Chinook Salmon*

Release-recovery Stock Monitored at Lower Granite Dam

The stock of subyearling fall chinook salmon smolts captured, PIT-tagged and released during April through July into the Snake River, near its confluence with the Salmon River (Section 2.1.1) has been monitored by the RealTime project since 1999. Like last year, the first half of the migration was very well-predicted (MAD = 2.0%) but the last half (also like last year) was not as well-predicted (Table 3.6).

Table 3.6: Mean absolute deviations (MADs) for the 2003 and 2004 outmigrations to Lower Granite Dam of PIT-tagged populations of wild Snake River fall subyearling chinook salmon. Columns show MADs for the entire run, the first 50% of the run, and the last 50% of the run.

	2003			2004		
Detection Location	Entire Run	First 50%	Last 50%	Entire Run	First 50%	Last 50%
Lower Granite Dam	2.77	1.96	3.12	5.31	1.28	7.40

Index-Count Stocks Monitored at McNary Dam

Both Snake and Upper Columbia River subyearling chinook salmon runs to McNary Dam were not as good in 2004 as last year (Table 3.7). The season-wide MADs for both of these stocks were 7.2% compared to 3.0% (Snake River) and 2.3% (Upper Columbia) last year. Passage timing for both were much earlier than historically.

Table 3.7: Mean absolute deviations (MADs) for the 2003 and 2004 outmigrations of PIT-tagged populations of wild Snake River fall subyearling chinook salmon and wild Upper Columbia River subyearling chinook salmon monitored at McNary Dam. Columns show MADs for the entire run, the first 50% of the run, and the last 50% of the run.

Stock	2003			2004		
	Entire Run	First 50%	Last 50%	Entire Run	First 50%	Last 50%
All Wild PIT-tagged Snake River Subyearling Chinook Salmon detected at McNary Dam	3.03	4.77	2.19	7.22	9.64	6.46
All Wild PIT-tagged Upper Columbia River Subyearling Chinook Salmon detected at McNary Dam	2.29	2.68	2.20	7.22	10.48	6.93

3.2 Hatchery-reared ESUs

The only hatchery-reared PIT-tagged stocks monitored by Program RealTime have been summer-run sockeye. In 2001 and in 2002, the stock was a composite of smolts released into Alturas Lake Creek, Redfish Lake Creek Trap and Sawtooth Trap. This year, only the stock from Redfish Lake (Figure 2.1) was tracked. The season-wide MAD for this year (7.8%) was comparable to last year (6.7%), with the observed migration timing earlier than the historical average (Table 3.8).

Table 3.8: Mean absolute deviations (MADs, section 2.4.3) for the 2003 and 2004 outmigrations to Lower Granite Dam of the PIT-tagged hatchery-reared sockeye from Redfish Lake. Columns show MADs for the entire run, the first 50% of the run, and the last 50% of the run.

Detection Location	2003			2004		
	Entire Run	First 50%	Last 50%	Entire Run	First 50%	Last 50%
Lower Granite Dam	6.68	3.68	7.31	7.76	9.12	7.34

3.3 Combined Wild and Hatchery Runs-At-Large

The runs of yearling chinook, sockeye, and coho salmon forecasted to Rock Island, McNary, and John Day Dams were consistent with 2003; with all season-wide MADs within +/- 2% of the year prior (Table 3.9). Steelhead trout though, had larger season-wide MADs at McNary (13.6% this year vs. 6.3%) and John Day (7.3% vs. 3.0%) Dams, but was consistent at Rocky Reach Dam (2.7% vs. 2.2%). Bonneville Dam was added this year to the sites that migration was forecasted and tracked. For yearling chinook, sockeye, and coho salmon, the predictions tracked quite well, 2.1% MAD's and under. Steelhead (6.4%) and subyearling chinook salmon (5.6%) MADs were about the same, and still quite good for their initial year of inclusion in the program.

Table 3.9: Mean absolute deviances (MADs, section 2.4.3) for the 2003 and 2004 outmigrations to Rock Island, McNary, John Day, and Bonneville Dams of FPC passage indices of the combined wild and hatchery runs-at-large of salmon and steelhead. Bonneville Dam was not a forecasting site in 2003. Columns show MADs for the entire run, the first 50% of the run, and the last 50% of the run.

Detection Site	Stock	2003 Entire Run	2003 First 50%	2003 Last 50%	2004 Entire Run	2004 First 50%	2004 Last 50%
Rocky Reach Dam	Yearling Chinook Salmon	2.80	5.01	2.06	4.08	8.03	2.47
	Steelhead Trout	2.17	1.50	2.55	2.68	3.44	2.43
	Coho Salmon	1.33	1.17	1.43	1.84	2.00	1.78
	Sockeye Salmon	3.15	1.82	3.60	3.45	7.83	2.18
	Subyearling Chinook Salmon	8.22	11.61	5.83	7.80	11.98	5.07
McNary Dam	Yearling Chinook Salmon	1.88	2.36	1.69	3.59	5.85	2.70
	Steelhead Trout	6.34	7.70	5.65	13.63	10.92	14.69
	Coho Salmon	4.23	3.10	5.12	5.80	6.02	5.64
	Sockeye Salmon	1.73	2.76	1.35	2.63	4.03	1.96
	Subyearling Chinook Salmon	2.05	1.45	2.24	2.81	1.19	3.19
John Day Dam	Yearling Chinook Salmon	4.09	5.52	3.25	2.05	0.74	2.79
	Steelhead Trout	3.01	3.47	2.71	7.32	6.57	7.73
	Coho Salmon	2.26	1.26	2.96	3.24	3.49	3.03
	Sockeye Salmon	3.95	3.70	4.08	1.94	1.89	1.97
	Subyearling Chinook Salmon	4.14	9.80	2.47	3.50	2.26	3.89
Bonneville Dam	Yearling Chinook Salmon	--	--	--	2.10	1.15	2.66
	Steelhead Trout	--	--	--	6.41	6.69	6.26
	Coho Salmon	--	--	--	1.73	0.58	2.14
	Sockeye Salmon	--	--	--	1.21	0.74	1.53
	Subyearling Chinook Salmon	--	--	--	5.63	10.05	4.64

4.0 Discussion

Program RealTime 2004 performance in predicting run-timing of FPC passage-indexed stocks and PIT-tagged stocks was fairly consistent with previous years. Yearling chinook salmon (PIT-tagged) improved from last year, with only 4 of 23 predicted runs having greater than 10% MADs, versus last year's 8 for those same 23 runs. Steelhead trout improved to have MADs for all four runs under 10% versus the one run last year above 10%. The wild run-at-large sockeye salmon run at McNary went from bad to worse (11.3% to 24.5%), while the hatchery sockeye from Redfish Lake had a MAD under 10% (consistent with last year). Subyearling chinook salmon were also consistent, with all three migration forecasts with MADs under 10% both this year and last. RealTime again did well with the FPC index-counts, with only one MAD greater than 10% (steelhead trout at McNary Dam) of the 20 forecasts performed this year. At Bonneville Dam, all forecasts were below 10%, which is outstanding for the first year.

Of the six predicted runs with greater than 10% MADs, the main problem appears to be atypical timing from the previous years that have been monitored. The runs for four of the six (Cape Horn and Sulfur Creeks, Lemhi River, all at Lower Granite Dam, and the wild sockeye run-at-large at McNary Dam) started earlier and finished more quickly than what has happened on average. An adjustment to the timing model to switch from the starting model to the Least-Squares pattern-matching model (section 2.4.1) earlier in the migration season should help these runs perform better in the future. The remaining two runs (PIT-tagged yearling chinook salmon from Bear Valley Creek at Lower Granite Dam and the FPC index-counts of wild and hatchery steelhead trout at McNary Dam) do not have obvious answer to why the predictions were so far off. In both cases, the observed runs tracked nicely with the mean observed run-timing in the past. These two runs will be investigated further to ensure the program set up was correct, prior to the 2005 migration year.

Table 4.1 displays the observed versus predicted counts of fish at each of the dams for all the index-count stocks used by RealTime in 2004. These expected counts are based on the historical average of counts at each site for each species, and it was rare that they were close to what actually was observed. In determining the status of outmigration for these stocks at each site, the simple method of using the historical average to gauge the present year's migration status is woefully inadequate. Program RealTime has shown that incorporating the additional information of a stock's historical outmigration characteristics (length of run, percentage of fish observed daily, etc.) dramatically improves the status predictions. This program has proven to be an excellent tool in the determination of migration status, and as the historical data accumulates, will continue to improve.

Table 4.1: Comparison of expected number of detections or passage indices and the observed numbers for all index-count stocks monitored by Program RealTime in 2004.

Rearing/ Data Type	Detection Site	Stock	Expected 2004 Counts	Observed 2004 Counts
Wild/PIT-tag	Lower Granite Dam	Spring/Summer Yearling Chinook	11,314	23,812
		Steelhead Trout	7,151	12,783
	McNary Dam	Snake River Yearling Chinook Salmon	9,059	13,622
		Snake River Steelhead Trout	2,915	2,613
		Upper Columbia River Steelhead Trout	3,196	22,320
		Snake & Upper Columbia River Steelhead Trout	5,912	25,316
		Snake River Sockeye Salmon	274	45
		Snake River Subyearling Chinook Salmon	267	744
		Upper Columbia River Subyearling Chinook Salmon	1,584	773
Combined Wild & Hatchery/FPC Passage Indices	Rock Island Dam	Yearling Chinook Salmon	26,450	12,574
		Steelhead Trout	20,191	10,735
		Coho Salmon	42,717	28,668
		Sockeye Salmon	14,098	7,114
		Subyearling Chinook Salmon	18,131	23,563
	McNary Dam	Yearling Chinook Salmon	2,247,464	1,085,821
		Steelhead Trout	666,429	125,285
		Coho Salmon	274,437	90,681
		Sockeye Salmon	718,945	309,002
		Subyearling Chinook Salmon	7,849,257	8,280,870
	John Day Dam	Yearling Chinook Salmon	1,105,459	1,005,416
		Steelhead Trout	770,241	257,272
		Coho Salmon	335,953	175,311
		Sockeye Salmon	367,546	235929
		Subyearling Chinook Salmon	1,837,433	1,694,629
	Bonneville Dam	Yearling Chinook Salmon	1,284,627	1,449,398
		Steelhead Trout	533,398	153,204
		Coho Salmon	1,048,294	918,385
		Sockeye Salmon	245,608	183,774
		Subyearling Chinook Salmon	1,558,220	2,662,730

5.0 Recommendations

It is recommended that wild PIT-tagged runs-at-large of subyearling fall chinook salmon, yearling chinook salmon, sockeye salmon and steelhead trout continue to be monitored and forecasted at both Lower Granite and McNary Dams, for the purpose of estimating outmigration timing of ESUs. It is also recommended that the individual stocks from the Salmon, Grande Ronde and Clearwater River drainages continue to be monitored and forecasted to Lower Granite Dam. The large combined wild and hatchery-reared runs-at-large of chinook, coho and sockeye salmon and steelhead trout should also be monitored at Rock Island, McNary, John Day, and Bonneville Dams. The RealTime project supplied critical information about passage and run-timing for these stocks in 2004.

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the Run-Timing of Wild Migrant Subyearling Chinook in the Snake River Basin Using Program RealTime. School of Fisheries, University of Washington, Seattle, Washington. Technical Report (accepted) to Bonneville Power Administration, Portland, Oregon, Project 91-051, Contract DEBI79-87BP35885. 31 p. (Available from Bonneville Power Administration, Division of Fish and Wildlife, P.O. Box 3621, Portland, OR. 97283-3621.)

Townsend, R. L., J. R. Skalski, and D. Yasuda. 2000. Evaluation of the 1997 Predictions of the Run-Timing of Wild Migrant Yearling and Subyearling Chinook and Sockeye in the Snake River Basin Using Program RealTime. School of Fisheries, University of Washington, Seattle, Washington. Technical Report to Bonneville Power Administration, Portland, Oregon, Project 91-051, Contract DE-BI79-87BP35885. 30 p. (Available from Bonneville Power Administration, Division of Fish and Wildlife, P.O. Box 3621, Portland, OR. 97283-3621.)

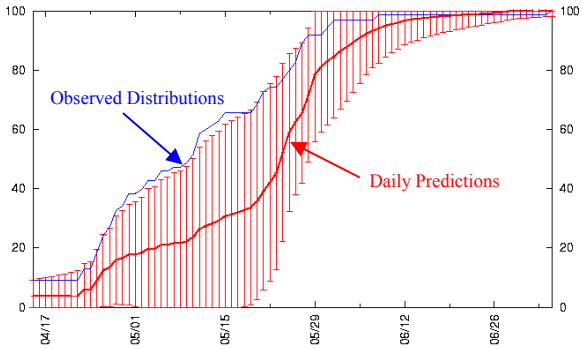
Appendix A

Performance Plots for the 2004 Outmigration Season

RealTime Daily Predicted vs. Observed Run-timing using PIT-tagged Fish

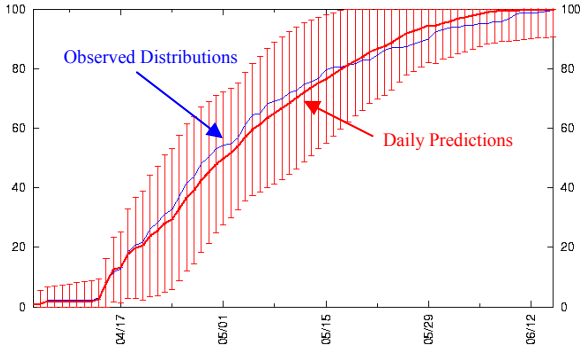
Figure A. 1: Daily predictions of run-timing at Lower Granite Dam of PIT-tagged wild yearling chinook salmon from Bear Valley Creek, Big Creek, Camas Creek and Cape Horn Creek, Catherine Creek and West Fork Chamberlain Creek.

Bear Valley Creek



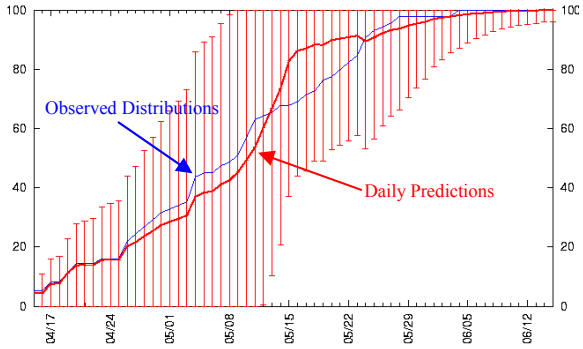
Passage Date at Lower Granite

Big Creek



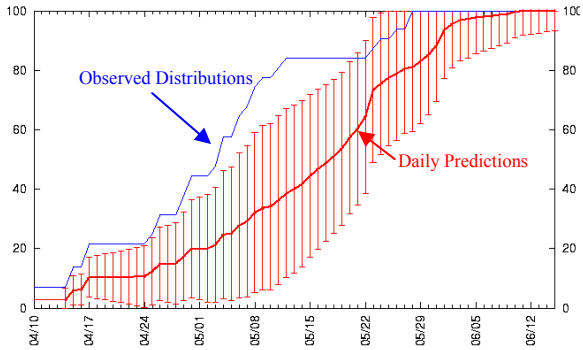
Passage Date at Lower Granite

Camas Creek



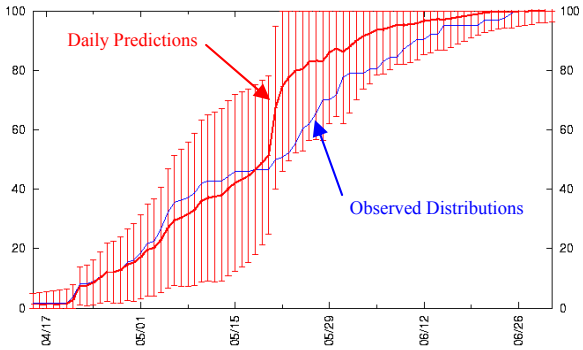
Passage Date at Lower Granite

Cape Horn Creek



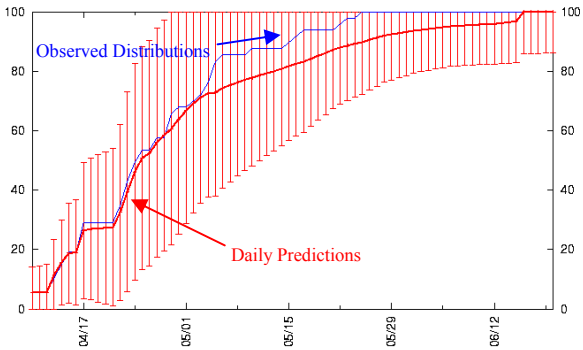
Passage Date at Lower Granite

Catherine Creek



Passage Date at Lower Granite

West Fork Chamberlain Creek



Passage Date at Lower Granite

Figure A. 2: Daily predictions of run-timing at Lower Granite Dam of PIT-tagged wild yearling chinook salmon from Elk Creek, Herd Creek, Imnaha River, Lake Creek, Lemhi River, and Lolo Creek.

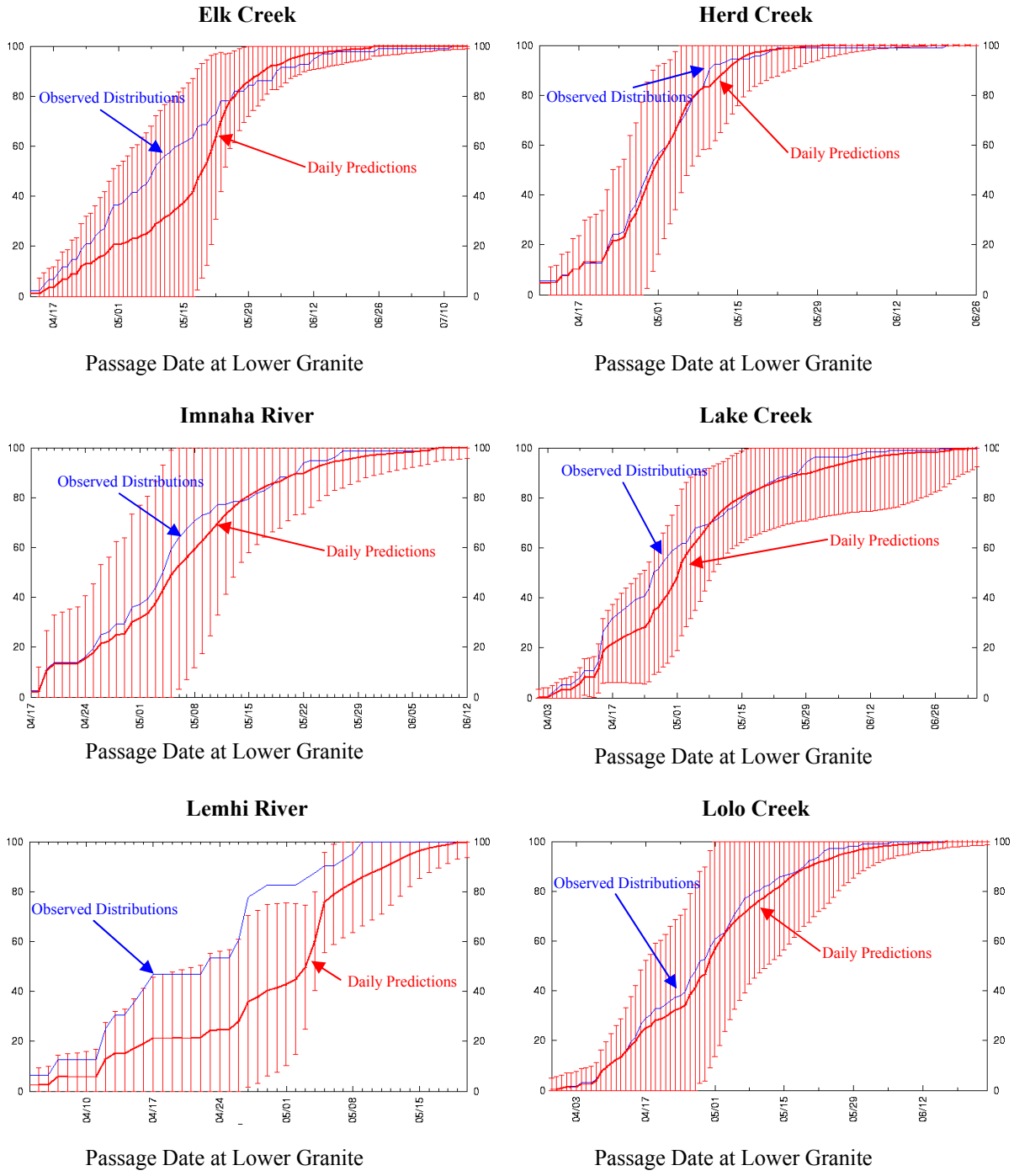
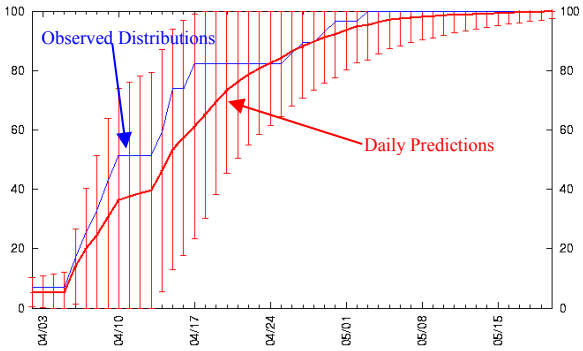


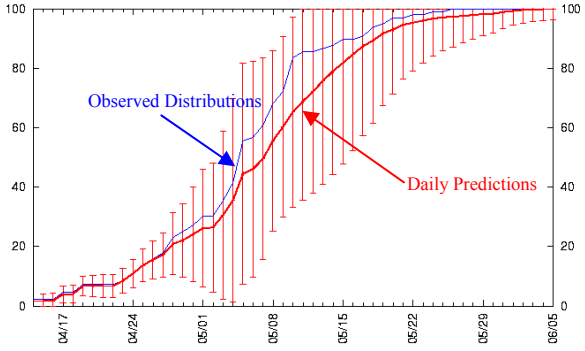
Figure A. 3: Daily predictions of run-timing at Lower Granite Dam of PIT-tagged wild yearling chinook salmon from Lookingglass Creek, Loon Creek, Lostine River, Marsh Creek, Minam River, and South Fork Salmon River.

Lookingglass Creek



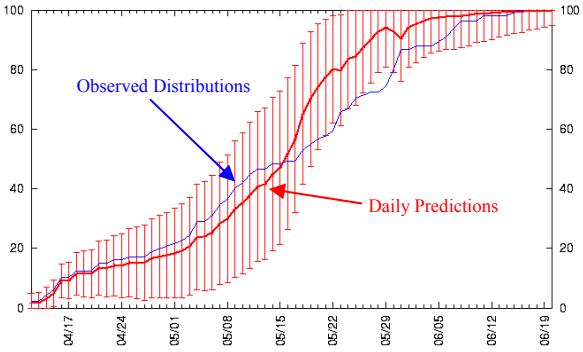
Passage Date at Lower Granite

Loon Creek



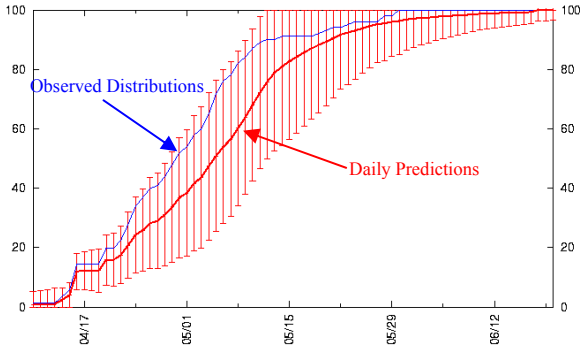
Passage Date at Lower Granite

Lostine River



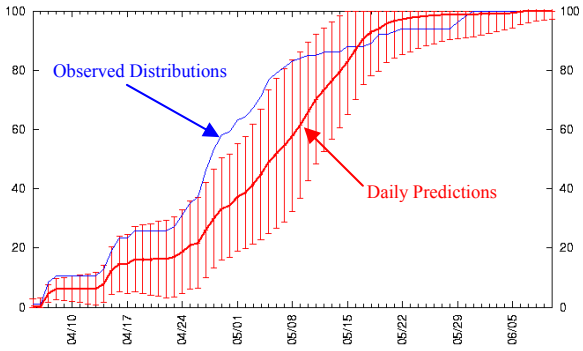
Passage Date at Lower Granite

Marsh Creek



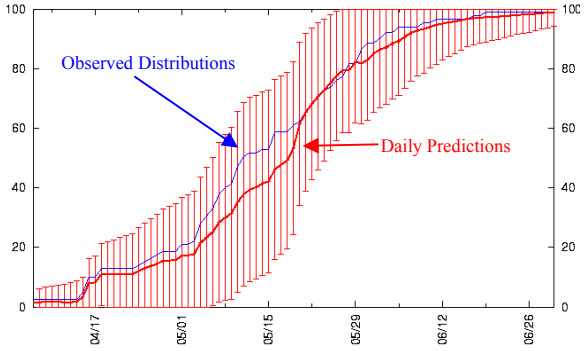
Passage Date at Lower Granite

Minam River



Passage Date at Lower Granite

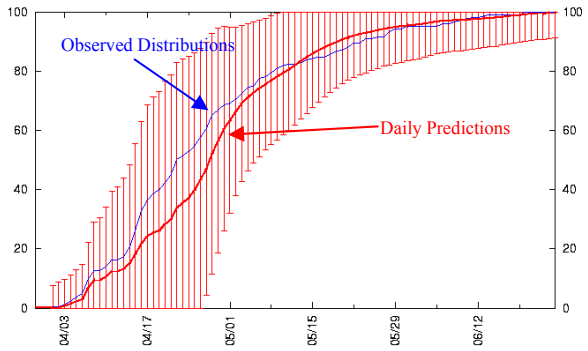
South Fork Salmon River



Passage Date at Lower Granite

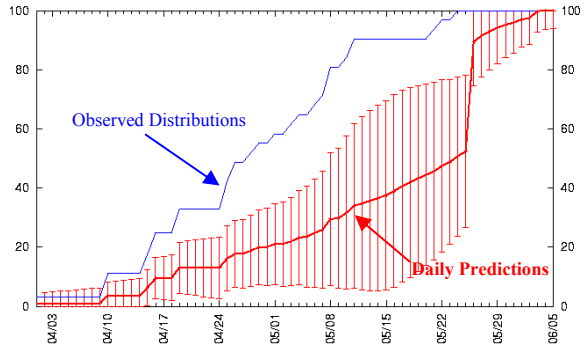
Figure A. 4: Daily predictions of run-timing at Lower Granite Dam of PIT-tagged wild yearling chinook salmon from Secesh River, Sulfur Creek, Valley Creek, the CRiSP Composite Run, and a composite of wild yearling chinook from the Snake River drainage at Lower Granite and McNary Dams .

Secesh River



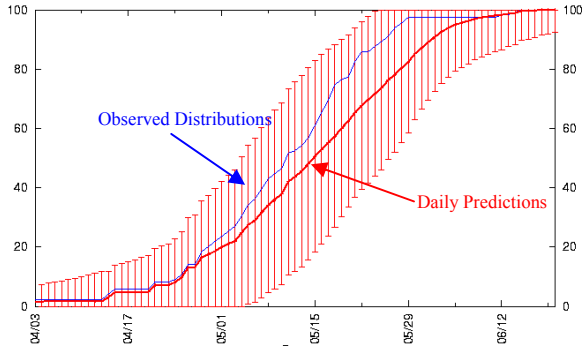
Passage Date at Lower Granite

Sulfur Creek



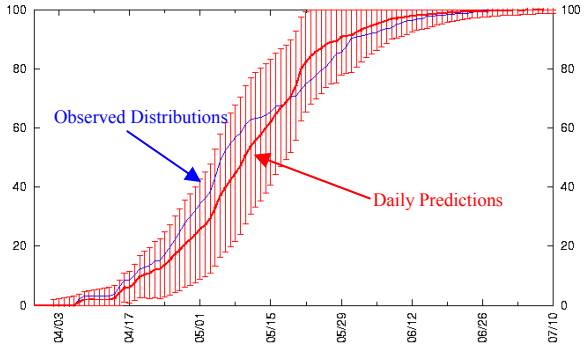
Passage Date at Lower Granite

Valley Creek



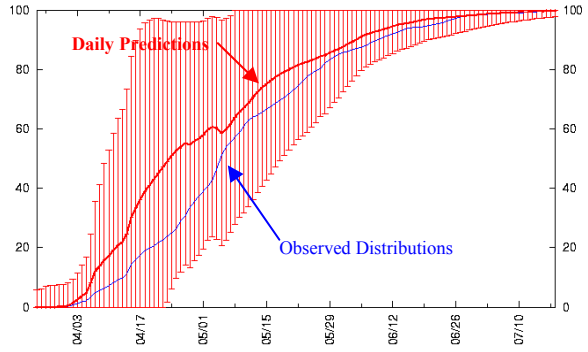
Passage Date at Lower Granite

CRiSP Composite



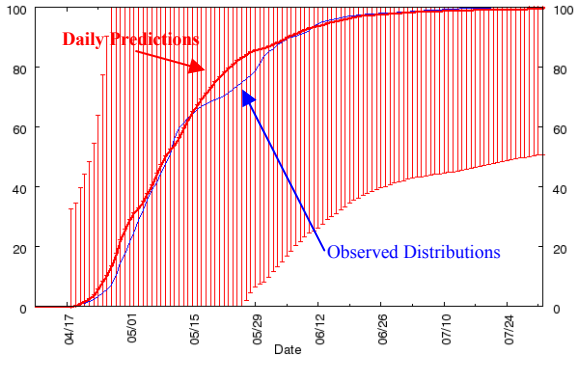
Passage Date at Lower Granite

Snake River Run-at-large at Lower Granite



Passage Date at Lower Granite

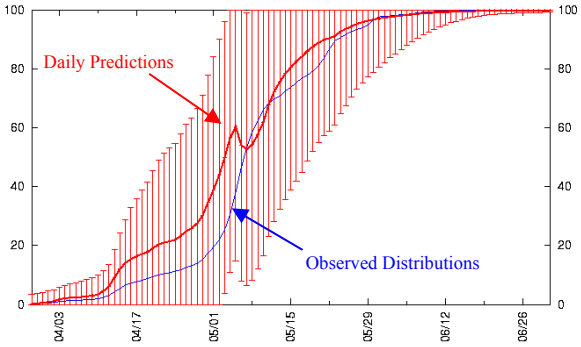
Snake River Run-at-large at McNary Dam



Passage Date at McNary

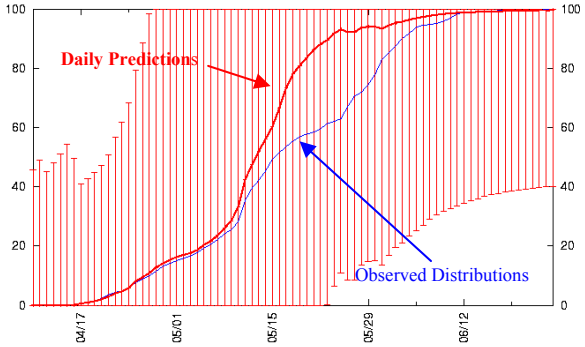
Figure A. 5: Daily predictions of run-timing of PIT-tagged wild steelhead trout from the Snake River drainage at Lower Granite Dam, and PIT-tagged wild steelhead trout from the Snake River drainage, Upper Columbia River, and a composite of the two sources at McNary Dam.

Snake River Run-at-large at Lower Granite



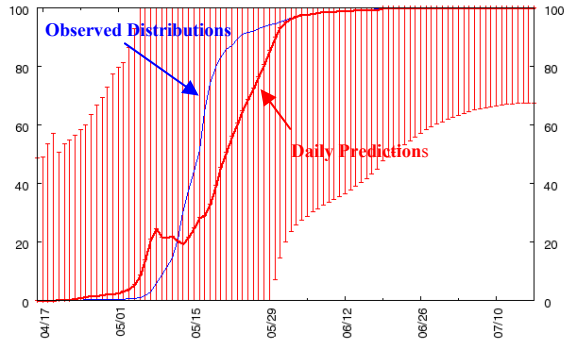
Passage Date at Lower Granite

Snake River Run-at-large at McNary Dam



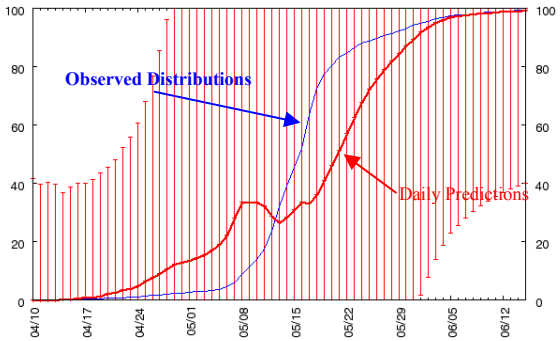
Passage Date at McNary

Upper Columbia River Run-at-large at McNary Dam



Passage Date at McNary

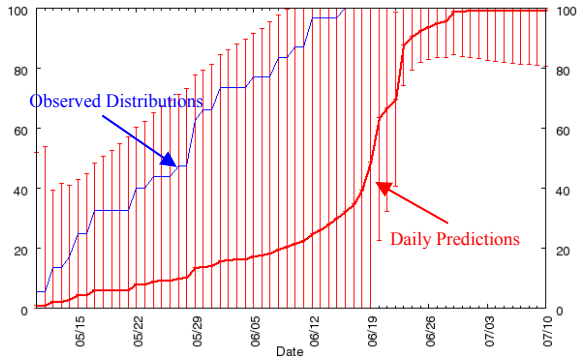
Composite Run-at-large at McNary Dam



Passage Date at McNary

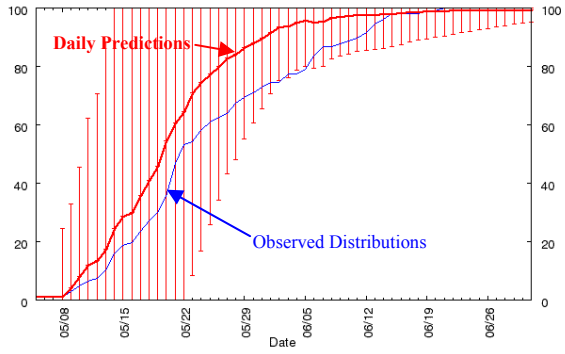
Figure A. 6: Daily predictions of run-timing of PIT-tagged wild sockeye salmon from the Snake River drainage at McNary Dam, and PIT-tagged hatchery sockeye from the Redfish Lake at Lower Granite Dam.

Snake River Wild Run-at-large at McNary



Passage Date at McNary Dam

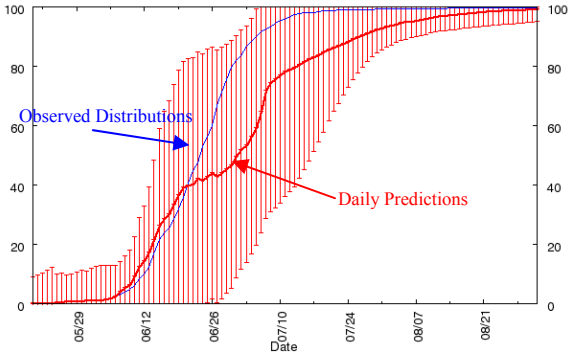
Redfish Lake Hatchery at Lower Granite



Passage Date at Lower Granite Dam

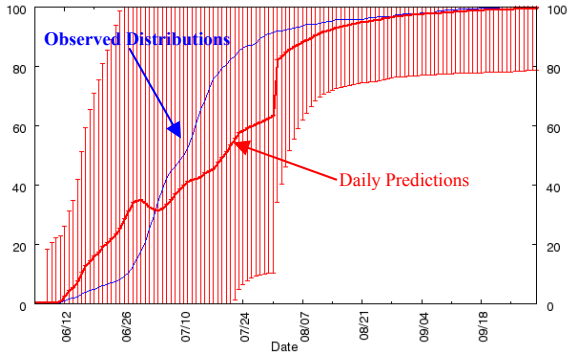
Figure A. 7: Daily predictions of run-timing of PIT-tagged wild subyearling chinook salmon from the Snake River drainage at Lower Granite and McNary Dams, and PIT-tagged wild subyearling chinook salmon from the Upper Columbia River at McNary Dam.

Snake River Run-at-large at Lower Granite



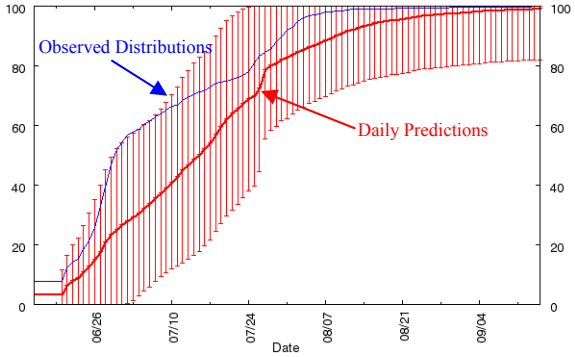
Passage Date at Lower Granite

Snake River Run-at-large at McNary Dam



Passage Date at McNary

Upper Columbia River Run-at-large at McNary Dam

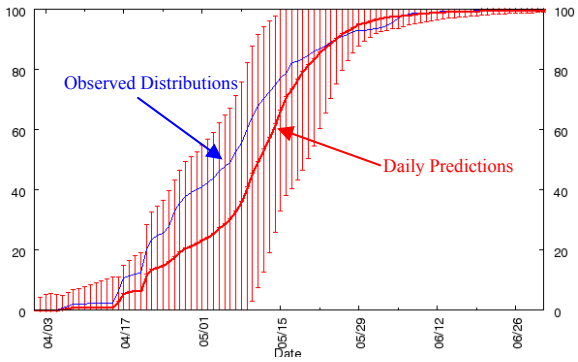


Passage Date at McNary

RealTime Daily Predicted vs. Observed Run-timing using FPC Passage-indexed Fish

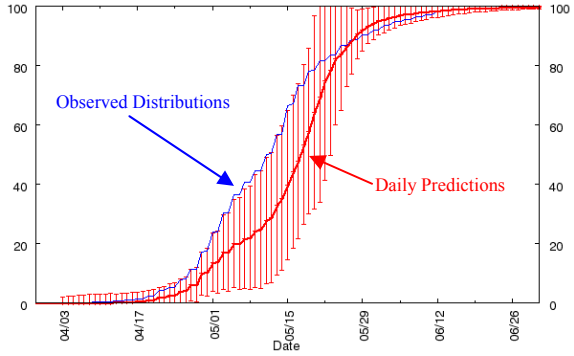
Figure A. 8: Daily predictions of run-timing of FPC passage-indexed combined wild and hatchery runs-at-large yearling chinook salmon at Rock Island, McNary, John Day, and Bonneville Dams.

Rock Island



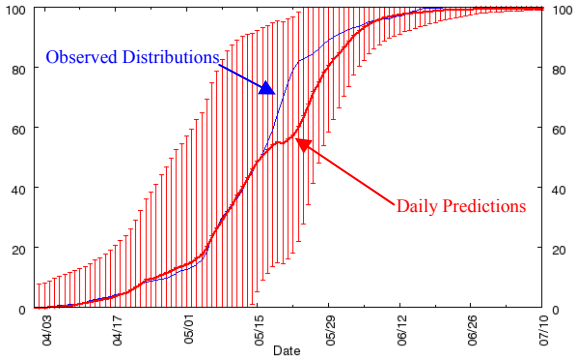
Passage Date at Rock Island Dam

McNary



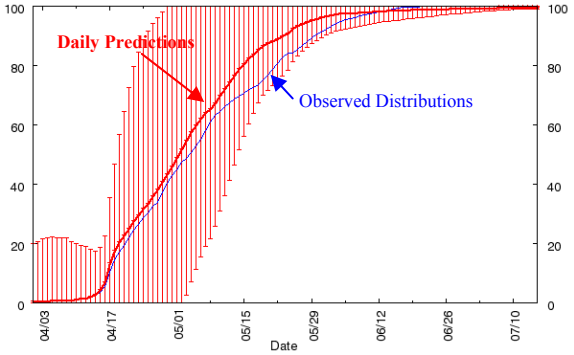
Passage Date at McNary Dam

John Day



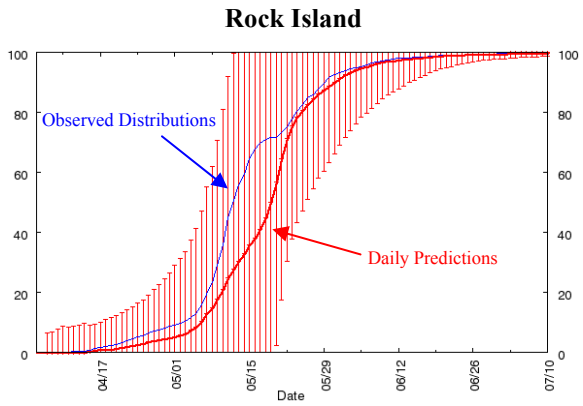
Passage Date at John Day Dam

Bonneville

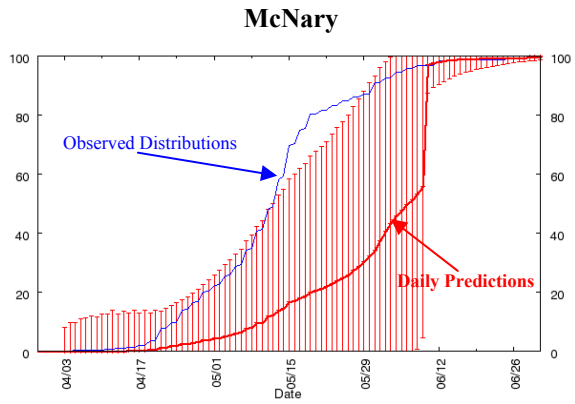


Passage Date at Bonneville Dam

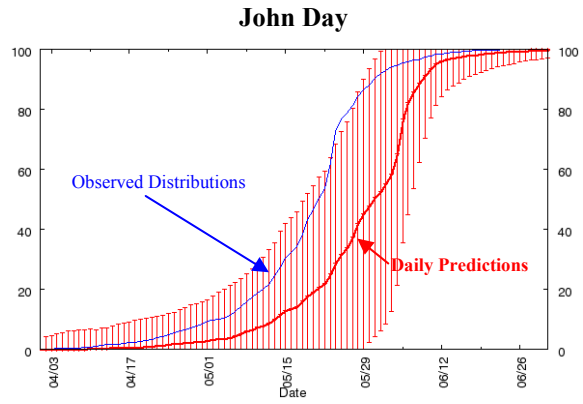
Figure A. 9: Daily predictions of run-timing of FPC passage-indexed combined wild and hatchery runs-at-large steelhead trout at Rock Island, McNary, John Day, and Bonneville Dams.



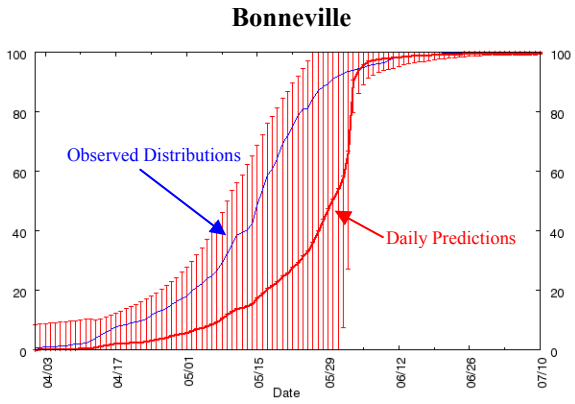
Passage Date at Rock Island Dam



Passage Date at McNary Dam



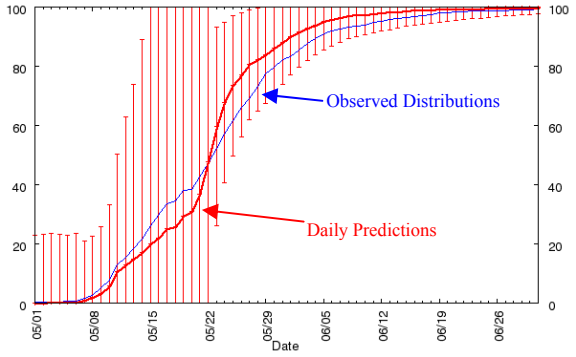
Passage Date at John Day Dam



Passage Date at Bonneville Dam

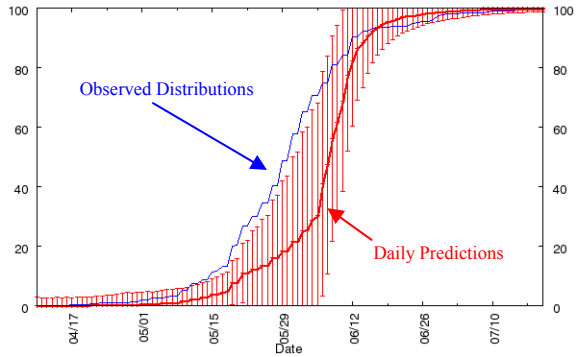
Figure A. 10: Daily predictions of run-timing of FPC passage-indexed combined wild and hatchery runs-at-large coho salmon at Rock Island, McNary, John Day, and Bonneville Dams.

Rock Island



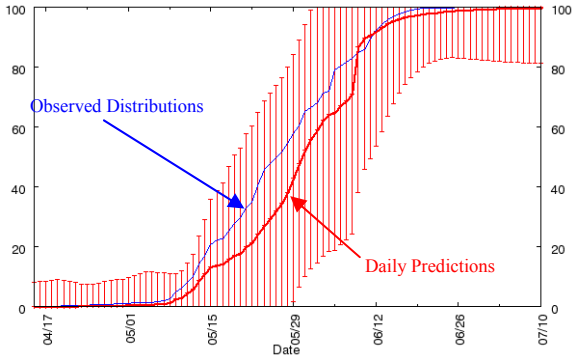
Passage Date at Rock Island Dam

McNary



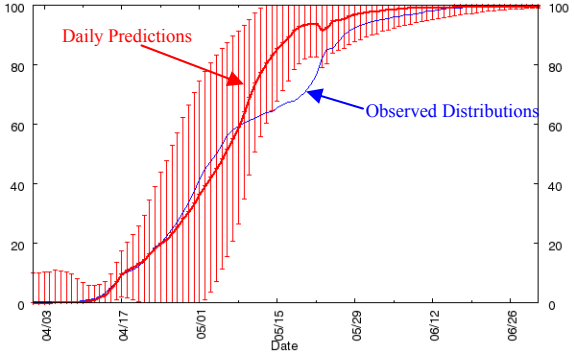
Passage Date at McNary Dam

John Day



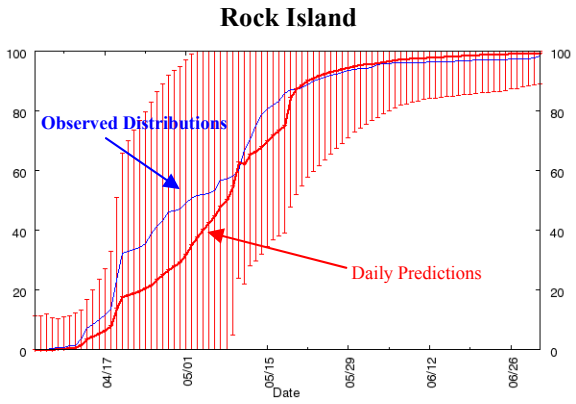
Passage Date at John Day Dam

Bonneville

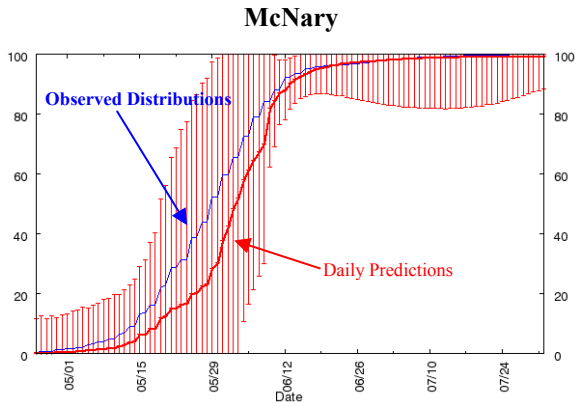


Passage Date at Bonneville Dam

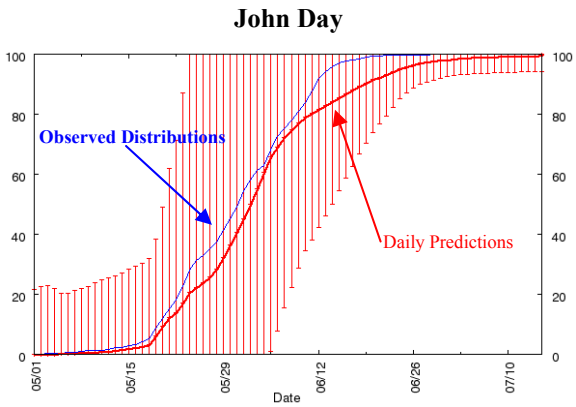
Figure A. 11: Daily predictions of run-timing of FPC passage-indexed combined wild and hatchery runs-at-large sockeye salmon at Rock Island, McNary, John Day, and Bonneville Dams.



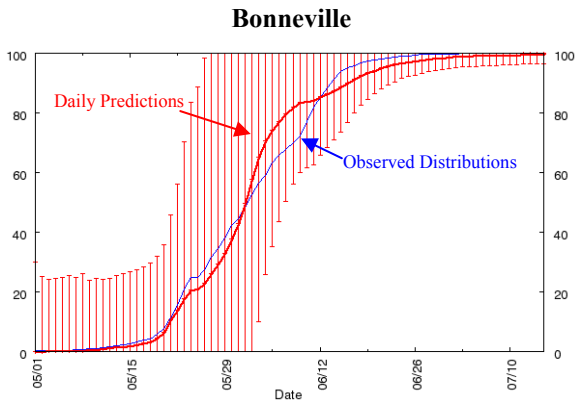
Passage Date at Rock Island Dam



Passage Date at McNary Dam

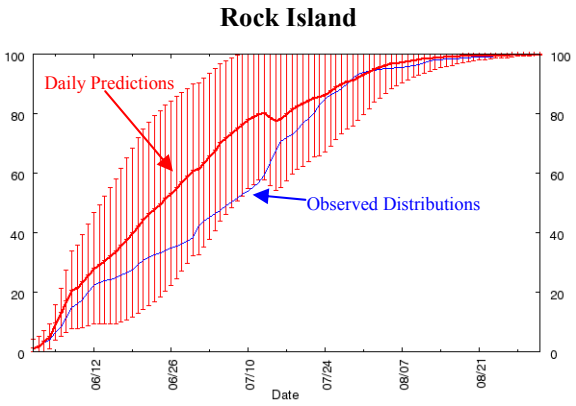


Passage Date at John Day Dam

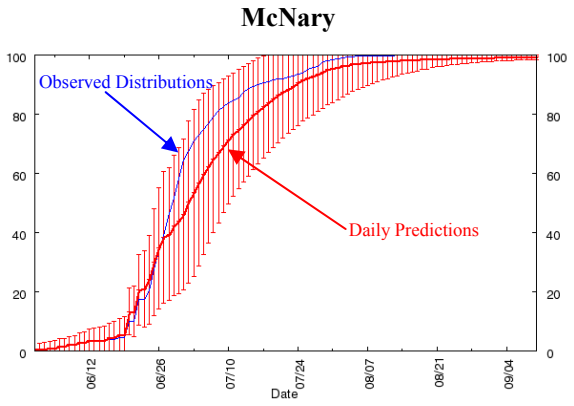


Passage Date at Bonneville Dam

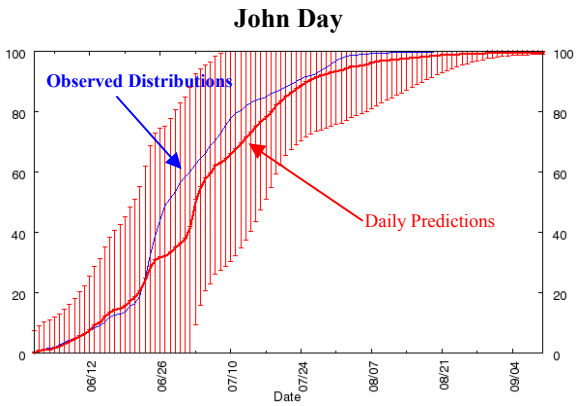
Figure A. 12: Daily predictions of run-timing of FPC passage-indexed combined wild and hatchery runs-at-large subyearling chinook salmon at Rock Island, McNary, John Day, and Bonneville Dams.



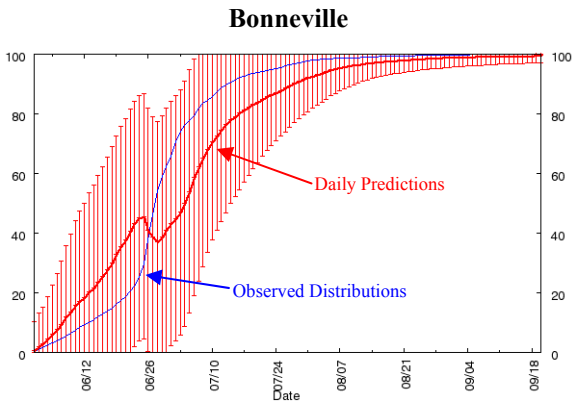
Passage Date at Rock Island Dam



Passage Date at McNary Dam

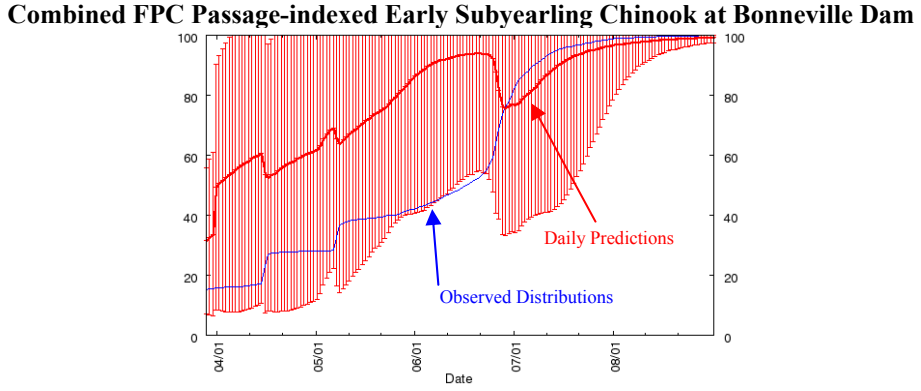


Passage Date at John Day Dam



Passage Date at Bonneville Dam

Figure A. 13: Daily predictions of run-timing of FPC passage-indexed combined wild and hatchery run-at-large of subyearling chinook salmon at Bonneville Dam, including hatchery releases starting as early as March.



Appendix B

Historical Timing Plots and Dates of Passage for the Stocks used in the RealTime Forecaster 2004 Outmigration Season

Figure B. 1: Historical outmigration run-timing at Lower Granite of PIT-tagged wild yearling chinook salmon from Bear Valley Creek.

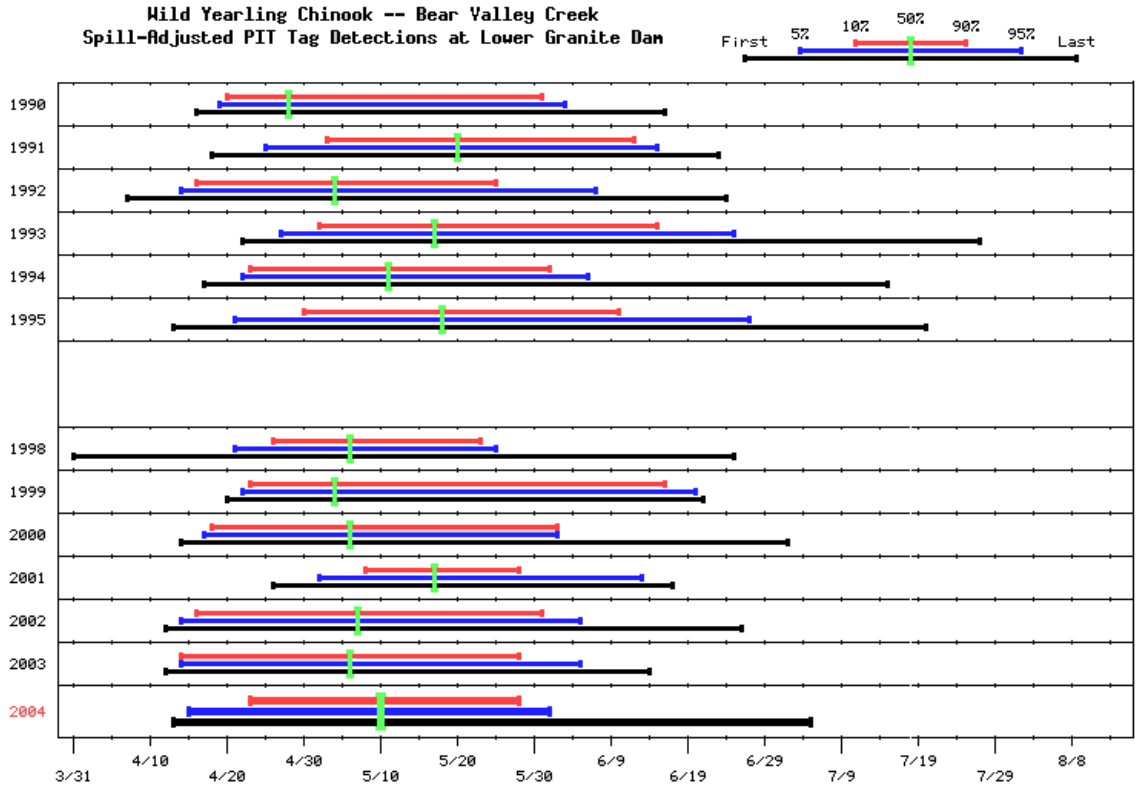


Table B. 1: Historical outmigration run-timing characteristics at Lower Granite of PIT-tagged wild yearling chinook salmon from Bear Valley Creek.

	Detection Date												
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	# Parr Released	LWG PIT Counts	Adjusted PIT Counts	% Oberserved
1990	04/16	04/16	04/19	04/20	04/28	05/31	06/03	06/16	42	471	31	31.0	6.6
1991	04/18	04/18	04/25	05/03	05/20	06/12	06/15	06/23	41	352	44	44.4	12.6
1992	04/07	04/07	04/14	04/16	05/04	05/25	06/07	06/24	40	944	57	57.0	6.0
1993	04/22	04/24	04/27	05/02	05/17	06/15	06/25	07/27	45	1015	67	105.1	10.4
1994	04/17	04/21	04/22	04/23	05/11	06/01	06/06	07/15	40	856	85	115.4	13.5
1995	04/13	04/16	04/21	04/30	05/18	06/10	06/27	07/20	42	1455	74	101.7	7.0
1998	03/31	04/14	04/21	04/26	05/06	05/23	05/25	06/25	28	427	59	113.5	26.6
1999	04/20	04/20	04/22	04/23	05/04	06/16	06/20	06/21	55	820	39	92.2	11.2
2000	04/14	04/14	04/17	04/18	05/06	06/02	06/02	07/02	46	837	44	85.1	10.2
2001	04/26	04/27	05/02	05/08	05/17	05/28	06/13	06/17	21	581	112	112.0	19.3
2002	04/12	04/12	04/14	04/16	05/07	05/31	06/05	06/26	46	1495	56	128.4	8.6
2003	04/12	04/12	04/14	04/14	05/06	05/28	06/05	06/14	45	1022	41	83.4	8.2
2004	04/13	04/13	04/15	04/23	05/10	05/28	06/01	07/05	36	1494	63	70.6	4.7

Figure B. 2: Historical outmigration run-timing at Lower Granite of PIT-tagged wild yearling chinook salmon from Big Creek.

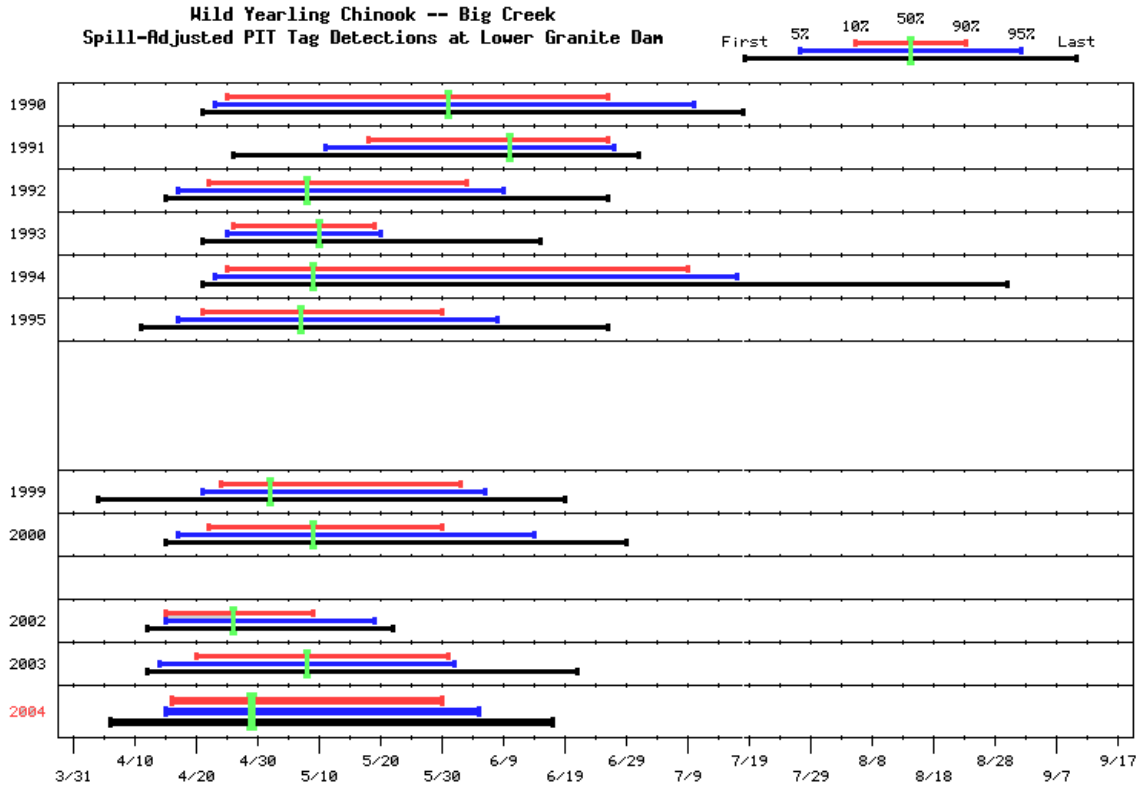


Table B. 2: Historical outmigration run-timing characteristics at Lower Granite of PIT-tagged wild yearling chinook salmon from Big Creek.

	Detection Date												
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	# Parr Released	LWG PIT Counts	Adjusted PIT Counts	% Oberserved
1990	04/21	04/21	04/23	04/25	05/31	06/26	07/10	07/18	63	1134	75	75.0	6.6
1991	04/26	04/26	05/11	05/18	06/10	06/26	06/27	07/01	40	724	67	67.8	9.4
1992	04/15	04/15	04/17	04/22	05/08	06/03	06/09	06/26	43	1002	57	57.0	5.7
1993	04/21	04/21	04/25	04/26	05/10	05/19	05/20	06/15	24	733	65	84.7	11.6
1994	04/21	04/21	04/23	04/25	05/09	07/09	07/17	08/30	76	721	56	68.7	9.5
1995	04/11	04/13	04/17	04/21	05/07	05/30	06/08	06/26	40	1482	164	220.2	14.9
1999	04/04	04/10	04/21	04/24	05/02	06/02	06/06	06/19	40	1427	100	242.1	17.0
2000	04/15	04/15	04/17	04/22	05/09	05/30	06/14	06/29	39	1090	92	177.2	16.3
2002	04/12	04/12	04/15	04/15	04/26	05/09	05/19	05/22	25	409	32	74.9	18.3
2003	04/12	04/12	04/14	04/20	05/08	05/31	06/01	06/21	42	1724	100	205.8	11.9
2004	04/06	04/06	04/15	04/16	04/29	05/30	06/05	06/17	45	2403	193	245.3	10.2

Figure B. 3: Historical outmigration run-timing at Lower Granite of PIT-tagged wild yearling chinook salmon from Camas Creek.

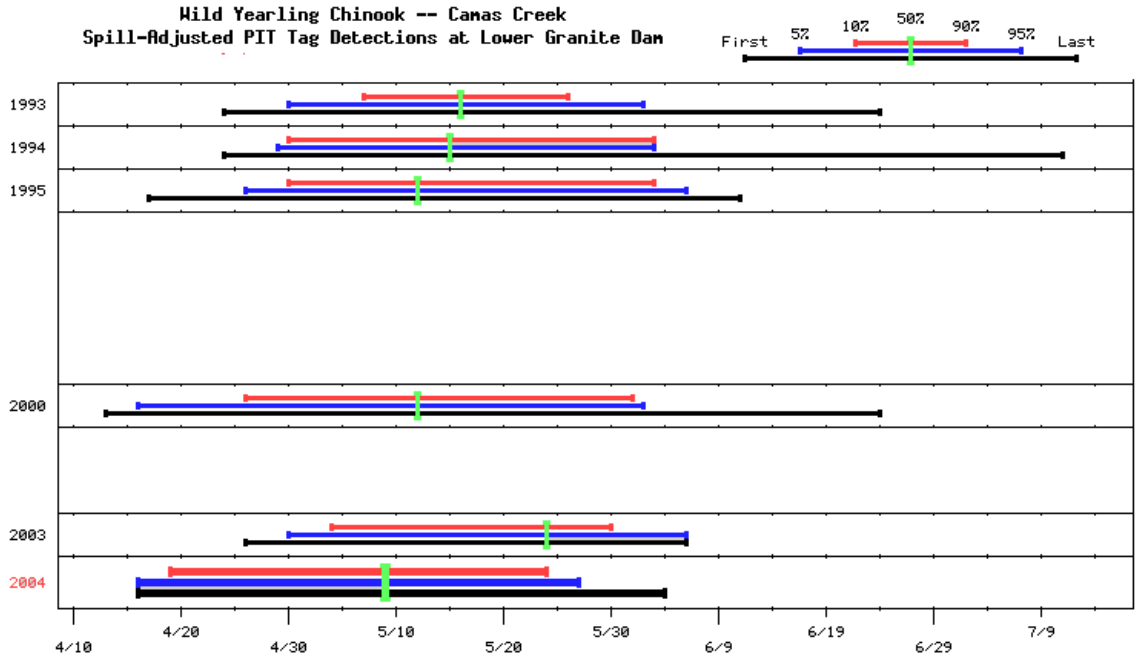


Table B. 3: Historical outmigration run-timing characteristics at Lower Granite of PIT-tagged wild yearling chinook salmon from Camas Creek.

	Detection Date												
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	# Parr Released	LWG PIT Counts	Adjusted PIT Counts	% Oberserved
1993	04/24	04/29	04/30	05/07	05/16	05/26	06/02	06/24	20	1013	66	109.2	10.8
1994	04/24	04/24	04/29	04/30	05/15	06/03	06/03	07/11	35	215	20	31.3	14.5
1995	04/17	04/17	04/26	04/30	05/12	06/03	06/06	06/11	35	1528	59	86.3	5.6
2000	04/13	04/13	04/16	04/26	05/12	06/01	06/02	06/24	37	763	53	103.7	13.6
2003	04/26	04/26	04/30	05/04	05/24	05/30	06/06	06/06	27	976	27	58.7	6.0
2004	04/16	04/16	04/16	04/19	05/09	05/24	05/27	06/04	36	1010	74	83.2	8.2

Figure B. 4: Historical outmigration run-timing at Lower Granite of PIT-tagged wild yearling chinook salmon from Cape Horn Creek.

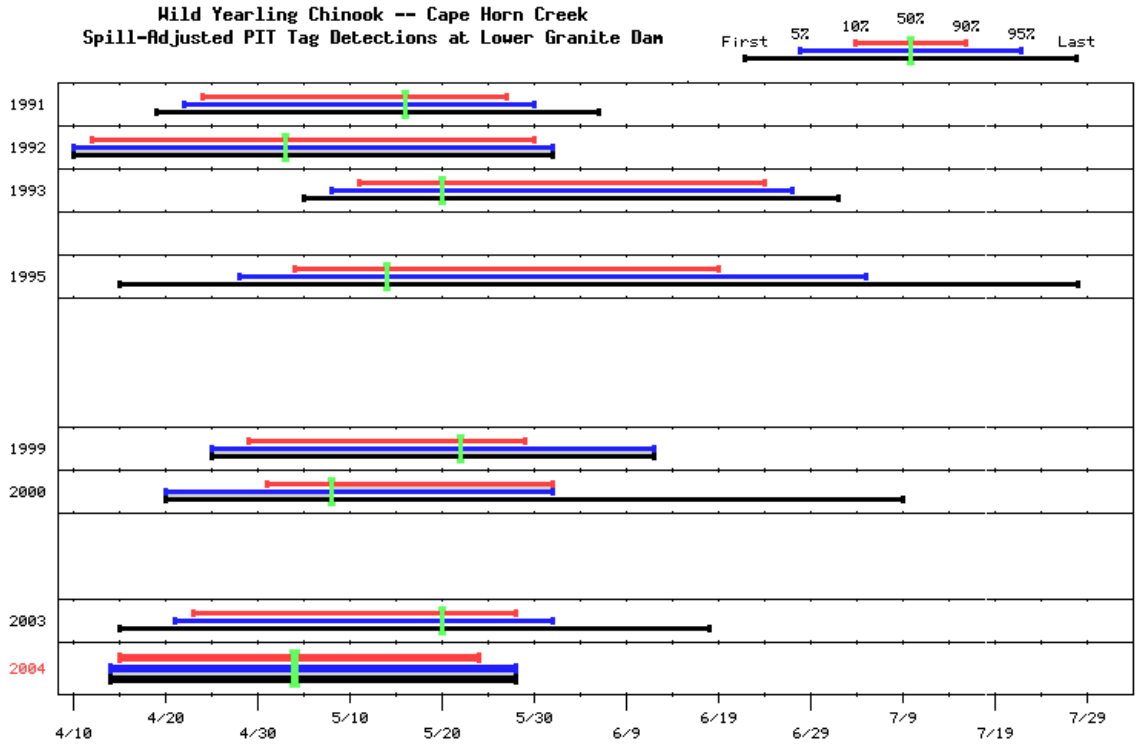


Table B. 4: Historical outmigration run-timing characteristics at Lower Granite of PIT-tagged wild yearling chinook salmon from Cape Horn Creek.

	Detection Date												
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	# Parr Released	LWG PIT Counts	Adjusted PIT Counts	% Oberserved
1991	04/19	04/19	04/22	04/24	05/16	05/27	05/30	06/06	34	164	25	25.4	15.5
1992	04/10	04/10	04/10	04/12	05/03	05/30	06/01	06/01	49	209	19	19.0	9.1
1993	05/05	05/05	05/08	05/11	05/20	06/24	06/27	07/02	45	205	22	34.4	16.8
1995	04/15	04/15	04/28	05/04	05/14	06/19	07/05	07/28	47	983	58	84.6	8.6
1999	04/25	04/25	04/25	04/29	05/22	05/29	06/12	06/12	31	270	15	35.8	13.3
2000	04/20	04/20	04/20	05/01	05/08	06/01	06/01	07/09	32	423	17	32.9	7.8
2003	04/15	04/15	04/21	04/23	05/20	05/28	06/01	06/18	36	562	25	52.2	9.3
2004	04/14	04/14	04/14	04/15	05/04	05/24	05/28	05/28	40	671	26	30.7	4.6

Figure B. 5: Historical outmigration run-timing at Lower Granite of PIT-tagged wild yearling chinook salmon from Catherine Creek.

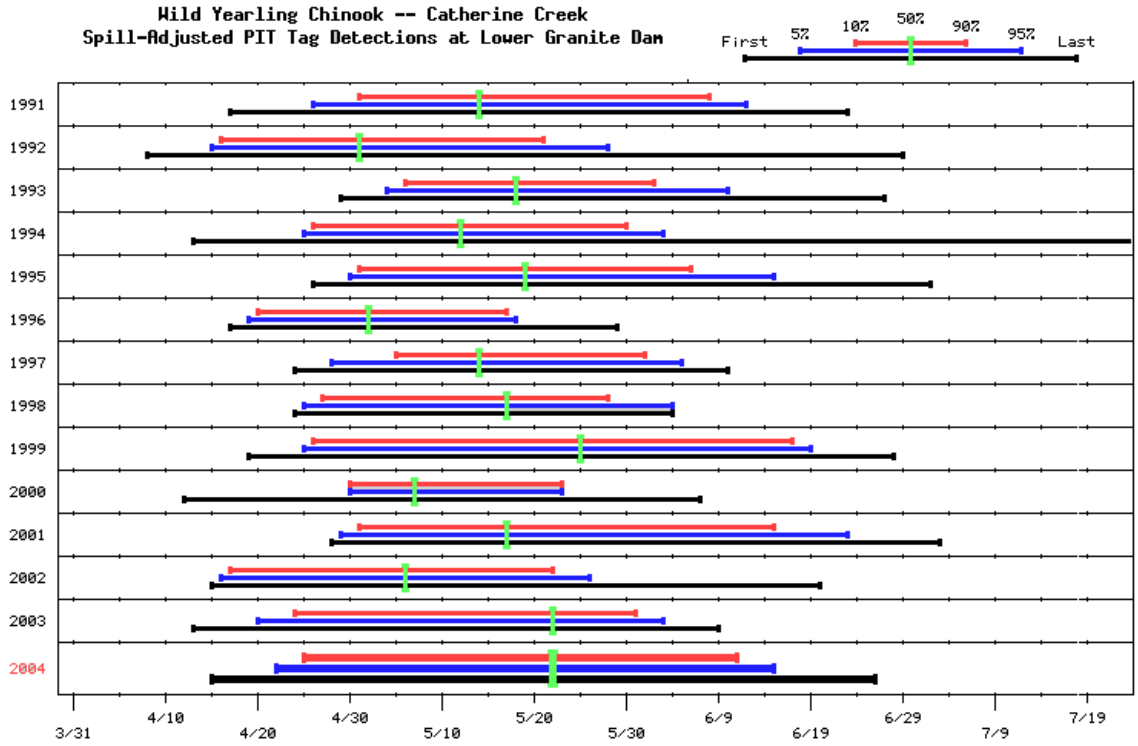


Table B. 5: Historical outmigration run-timing characteristics at Lower Granite of PIT-tagged wild yearling chinook salmon from Catherine Creek.

	Detection Date												
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	# Parr Released	LWG PIT Counts	Adjusted PIT Counts	% Oberserved
1991	04/17	04/17	04/26	05/01	05/14	06/08	06/12	06/23	39	1012	77	77.8	7.7
1992	04/08	04/08	04/15	04/16	05/01	05/21	05/28	06/29	36	940	67	67.0	7.1
1993	04/29	04/29	05/04	05/06	05/18	06/02	06/10	06/27	28	1093	102	158.2	14.5
1994	04/13	04/23	04/25	04/26	05/12	05/30	06/03	07/26	35	1000	76	110.5	11.0
1995	04/26	04/28	04/30	05/01	05/19	06/06	06/15	07/02	37	1301	115	153.8	11.8
1996	04/17	04/17	04/19	04/20	05/02	05/17	05/18	05/29	28	499	40	86.2	17.3
1997	04/24	04/24	04/28	05/05	05/14	06/01	06/05	06/10	28	585	51	120.2	20.6
1998	04/24	04/24	04/25	04/27	05/17	05/28	06/04	06/04	32	500	43	91.3	18.3
1999	04/19	04/19	04/25	04/26	05/25	06/17	06/19	06/28	53	949	44	107.9	11.4
2000	04/12	04/12	04/30	04/30	05/07	05/23	05/23	06/07	24	499	30	57.2	11.5
2001	04/28	04/28	04/29	05/01	05/17	06/15	06/23	07/03	46	501	33	33.0	6.6
2002	04/15	04/15	04/16	04/17	05/06	05/22	05/26	06/20	36	970	36	82.1	8.5
2003	04/13	04/14	04/20	04/24	05/22	05/31	06/03	06/09	38	2501	99	217.5	8.7
2004	04/15	04/15	04/22	04/25	05/22	06/11	06/15	06/26	48	1340	106	124.8	9.3

Figure B. 6: Historical outmigration run-timing at Lower Granite of PIT-tagged wild yearling chinook salmon from West Fork Chamberlain Creek.

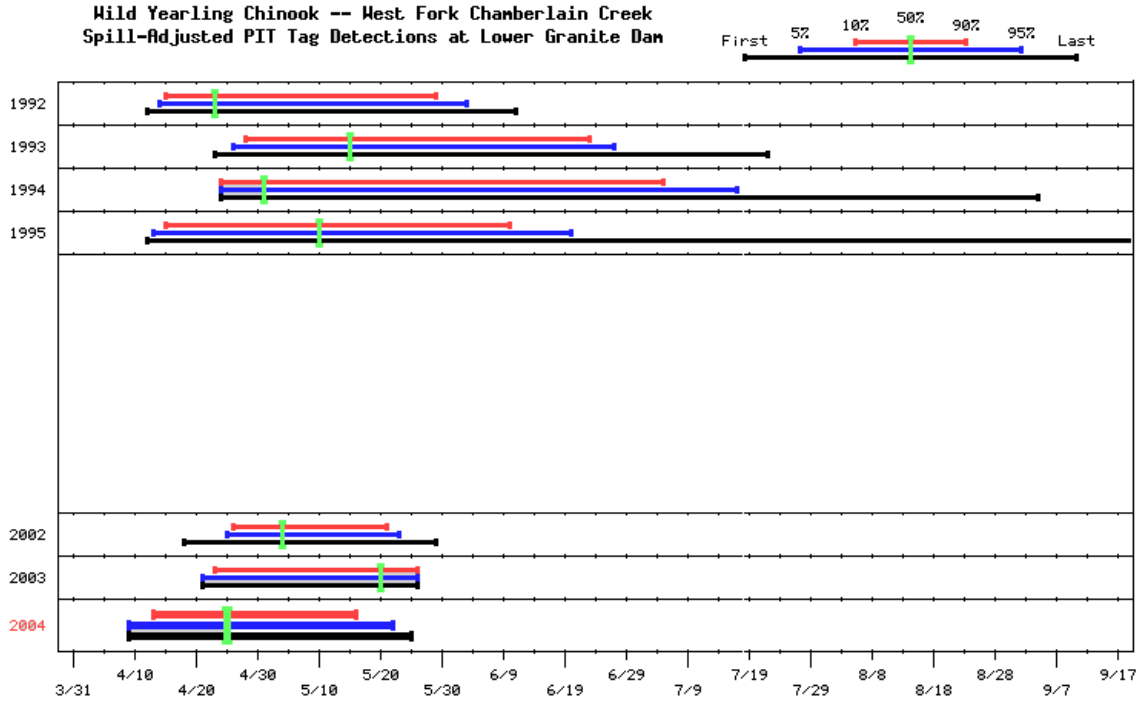


Table B. 6: Historical outmigration run-timing characteristics at Lower Granite of PIT-tagged wild yearling chinook salmon from West Fork Chamberlain Creek.

	Detection Date												
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	# Parr Released	LWG PIT Counts	Adjusted PIT Counts	% Oberserved
1992	04/12	04/12	04/14	04/15	04/23	05/29	06/03	06/11	45	1057	47	47.0	4.4
1993	04/23	04/23	04/26	04/28	05/15	06/23	06/27	07/22	57	498	49	58.6	11.8
1994	04/24	04/24	04/24	04/24	05/01	07/05	07/17	09/04	73	496	31	32.3	6.5
1995	04/12	04/12	04/13	04/15	05/10	06/10	06/20	09/22	57	916	43	59.5	6.5
2002	04/18	04/18	04/25	04/26	05/04	05/21	05/23	05/29	26	527	24	56.7	10.8
2003	04/21	04/21	04/21	04/23	05/20	05/26	05/26	05/26	34	761	16	33.1	4.3
2004	04/09	04/09	04/09	04/13	04/25	05/16	05/22	05/25	34	753	37	48.3	6.4

Figure B. 7: Historical outmigration run-timing at Lower Granite of PIT-tagged wild yearling chinook salmon from Elk Creek.

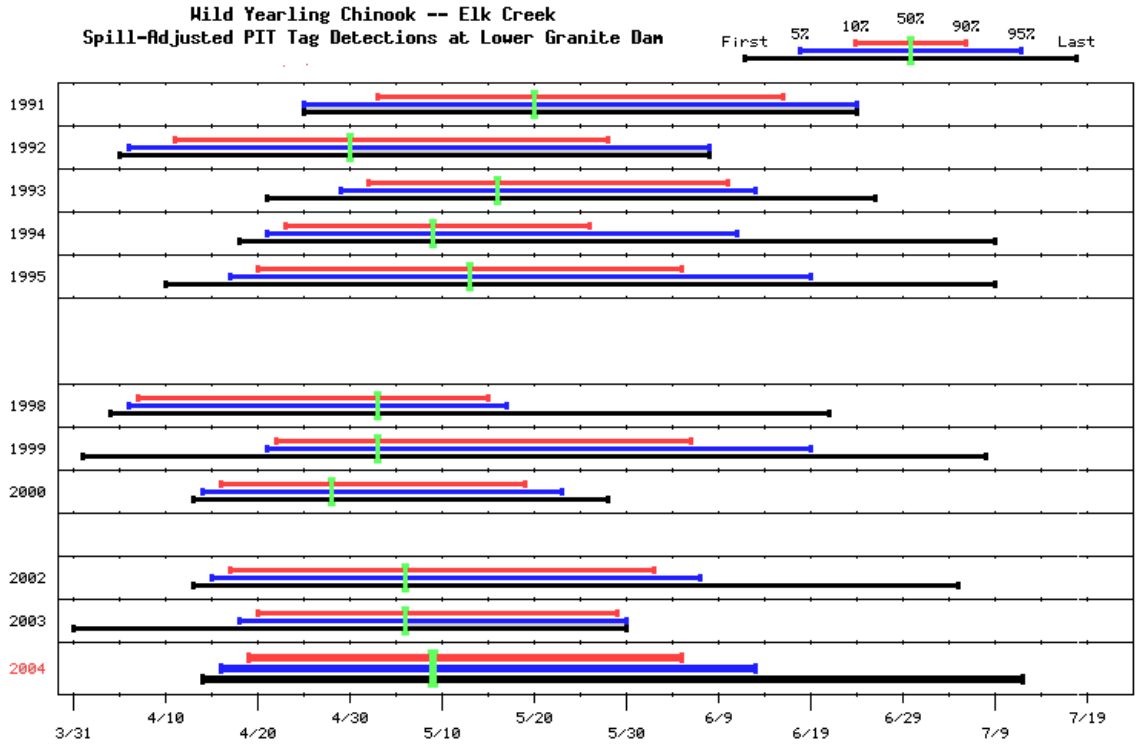


Table B. 7: Historical outmigration run-timing characteristics at Lower Granite of PIT-tagged wild yearling chinook salmon from Elk Creek.

	Detection Date												
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	# Parr Released	LWG PIT Counts	Adjusted PIT Counts	% Oberserved
1991	04/25	04/25	04/25	05/03	05/20	06/16	06/24	06/24	45	247	32	32.8	13.3
1992	04/05	04/05	04/06	04/11	04/30	05/28	06/08	06/08	48	462	36	36.0	7.8
1993	04/21	04/21	04/29	05/02	05/16	06/10	06/13	06/26	40	628	42	63.8	10.2
1994	04/18	04/18	04/21	04/23	05/09	05/26	06/11	07/09	34	998	76	96.4	9.7
1995	04/10	04/11	04/17	04/20	05/13	06/05	06/19	07/09	47	1512	75	100.4	6.6
1998	04/04	04/04	04/06	04/07	05/03	05/15	05/17	06/21	39	246	57	104.0	42.3
1999	04/01	04/01	04/21	04/22	05/03	06/06	06/19	07/08	46	700	44	99.1	14.2
2000	04/13	04/13	04/14	04/16	04/28	05/19	05/23	05/28	34	660	42	80.3	12.2
2002	04/13	04/13	04/15	04/17	05/06	06/02	06/07	07/05	47	1519	35	77.2	5.1
2003	03/31	03/31	04/18	04/20	05/06	05/29	05/30	05/30	40	975	27	55.5	5.7
2004	04/14	04/14	04/16	04/19	05/09	06/05	06/13	07/12	48	1520	83	96.5	6.4

Figure B. 8: Historical outmigration run-timing at Lower Granite of PIT-tagged wild yearling chinook salmon from Herd Creek.

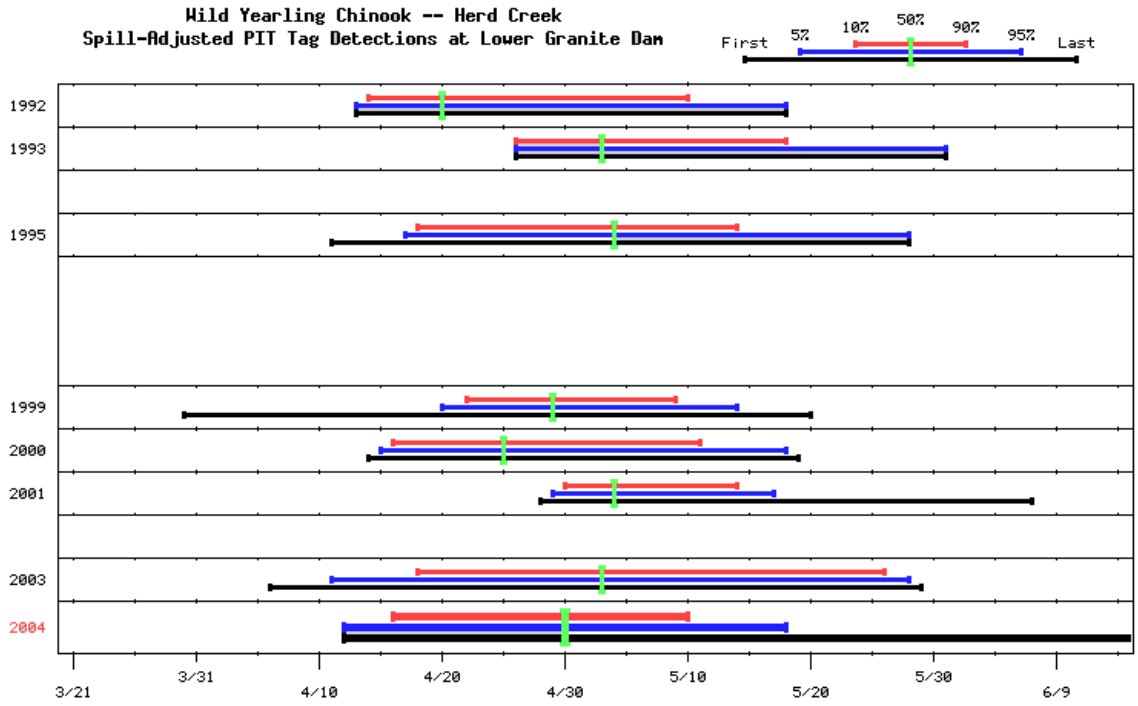


Table B. 8: Historical outmigration run-timing characteristics at Lower Granite of PIT-tagged wild yearling chinook salmon from Herd Creek.

Detection Year	Detection Date								Middle 80% (days)	# Parr Released	LWG PIT Counts	Adjusted PIT Counts	% Oberserved
	First	1%	5%	10%	50%	90%	95%	Last					
1992	04/13	04/13	04/13	04/14	04/20	05/10	05/18	05/18	27	310	17	17.0	5.5
1993	04/26	04/26	04/26	04/26	05/03	05/18	05/31	05/31	23	224	16	19.5	8.7
1995	04/11	04/11	04/17	04/18	05/04	05/14	05/28	05/28	27	534	36	46.2	8.7
1999	03/30	04/11	04/20	04/22	04/29	05/09	05/14	05/20	18	959	58	136.2	14.2
2000	04/14	04/14	04/15	04/16	04/25	05/11	05/18	05/19	26	315	23	44.3	14.1
2001	04/28	04/28	04/29	04/30	05/04	05/14	05/17	06/07	15	311	66	66.0	21.2
2003	04/06	04/06	04/11	04/18	05/03	05/26	05/28	05/29	39	799	37	75.8	9.5
2004	04/12	04/12	04/12	04/16	04/30	05/10	05/18	06/21	25	968	81	93.4	9.7

Figure B. 9: Historical outmigration run-timing at Lower Granite of PIT-tagged wild yearling chinook salmon from Imnaha River.

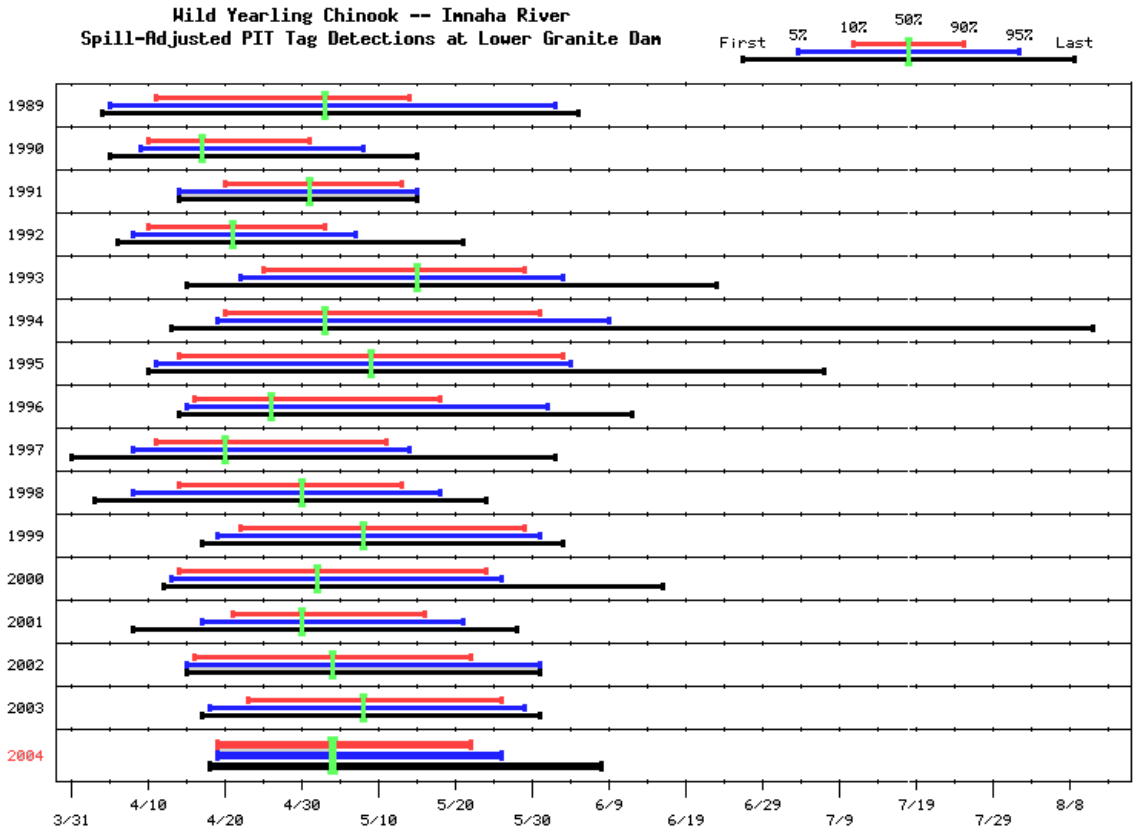


Table B. 9: Historical outmigration run-timing characteristics at Lower Granite of PIT-tagged wild yearling chinook salmon from Imnaha River.

	Detection Date												
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	# Parr Released	LWG PIT Counts	Adjusted PIT Counts	% Oberserved
1989	04/04	04/04	04/05	04/11	05/03	05/14	06/02	06/05	34	588	36	36.0	6.1
1990	04/05	04/05	04/09	04/10	04/17	05/01	05/08	05/15	22	897	69	69.0	7.7
1991	04/14	04/14	04/14	04/20	05/01	05/13	05/15	05/15	24	327	18	18.0	5.5
1992	04/06	04/06	04/08	04/10	04/21	05/03	05/07	05/21	24	758	73	73.0	9.6
1993	04/15	04/15	04/22	04/25	05/15	05/29	06/03	06/23	35	1003	63	88.3	8.8
1994	04/13	04/13	04/19	04/20	05/03	05/31	06/09	08/11	42	1167	91	104.2	8.9
1995	04/10	04/10	04/11	04/14	05/09	06/03	06/04	07/07	51	996	40	50.9	5.1
1996	04/14	04/14	04/15	04/16	04/26	05/18	06/01	06/12	33	997	97	233.5	23.4
1997	03/31	04/03	04/08	04/11	04/20	05/11	05/14	06/02	31	1017	98	191.1	18.8
1998	04/03	04/03	04/08	04/14	04/30	05/13	05/18	05/24	30	1010	159	283.5	28.1
1999	04/17	04/17	04/19	04/22	05/08	05/29	05/31	06/03	38	1009	41	97.7	9.7
2000	04/12	04/12	04/13	04/14	05/02	05/24	05/26	06/16	41	982	63	119.5	12.2
2001	04/08	04/10	04/17	04/21	04/30	05/16	05/21	05/28	26	1000	159	159.0	15.9
2002	04/15	04/15	04/15	04/16	05/04	05/22	05/31	05/31	37	1001	15	33.5	3.3
2003	04/17	04/17	04/18	04/23	05/08	05/26	05/29	05/31	34	1003	43	87.5	8.7
2004	04/18	04/18	04/19	04/19	05/04	05/22	05/26	06/08	34	998	81	90.5	9.1

Figure B. 10: Historical outmigration run-timing at Lower Granite of PIT-tagged wild yearling chinook salmon from Lake Creek.

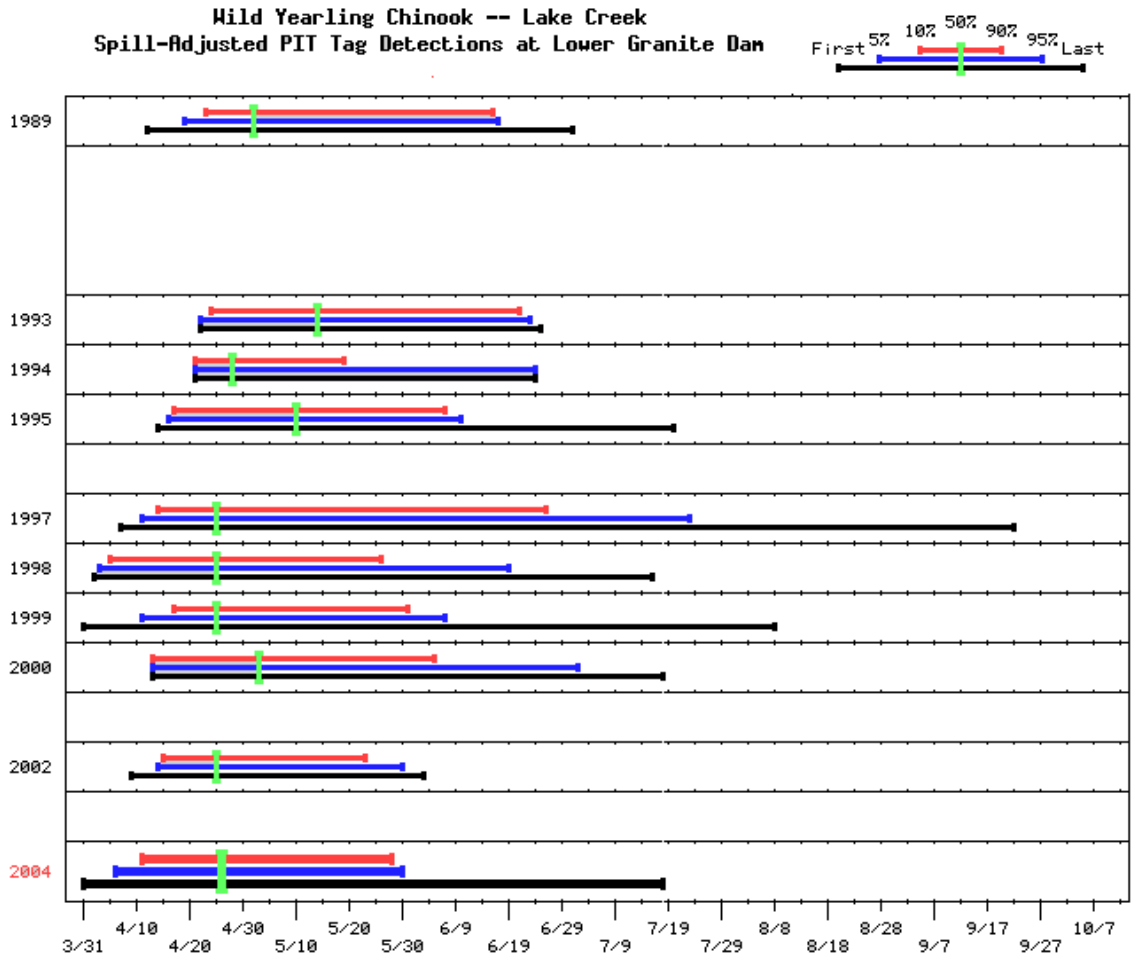


Table B. 10: Historical outmigration run-timing characteristics at Lower Granite of PIT-tagged wild yearling chinook salmon from Lake Creek.

	Detection Date												
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	# Parr Released	LWG PIT Counts	Adjusted PIT Counts	% Oberserved
1989	04/12	04/12	04/19	04/23	05/02	06/16	06/17	07/01	55	657	51	51.0	7.8
1993	04/22	04/22	04/22	04/24	05/14	06/21	06/23	06/25	59	255	27	31.1	12.2
1994	04/21	04/21	04/21	04/21	04/28	05/19	06/24	06/24	29	252	17	19.8	7.9
1995	04/14	04/14	04/16	04/17	05/10	06/07	06/10	07/20	52	405	25	33.2	8.2
1997	04/07	04/07	04/11	04/14	04/25	06/26	07/23	09/22	74	400	22	41.8	10.4
1998	04/02	04/02	04/03	04/05	04/25	05/26	06/19	07/16	52	418	48	80.3	19.2
1999	03/31	04/03	04/11	04/17	04/25	05/31	06/07	08/08	45	5267	306	705.0	13.4
2000	04/13	04/13	04/13	04/13	05/03	06/05	07/02	07/18	54	603	30	54.5	9.0
2002	04/09	04/09	04/14	04/15	04/25	05/23	05/30	06/03	39	3193	94	207.8	6.5
2004	03/31	04/04	04/06	04/11	04/27	05/28	05/30	07/18	48	2668	132	177.7	6.7

Figure B. 11: Historical outmigration run-timing at Lower Granite of PIT-tagged wild yearling chinook salmon from Lemhi River.

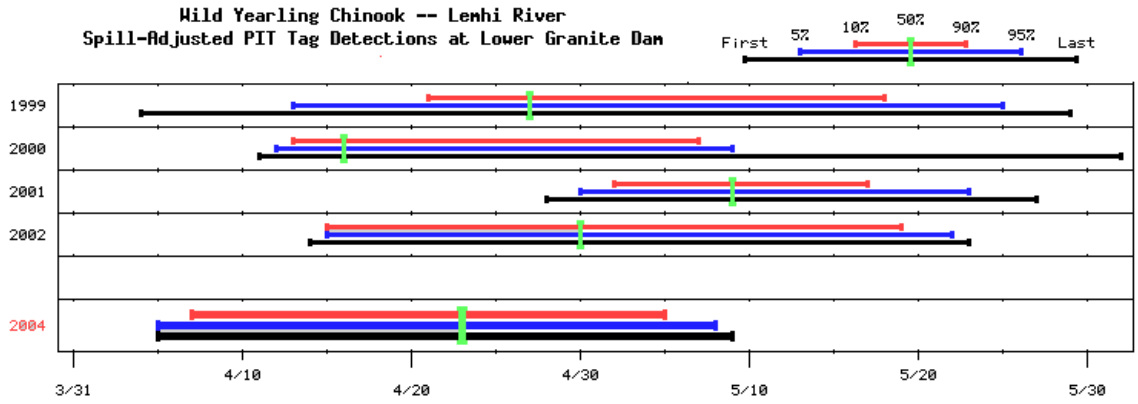


Table B. 11: Historical outmigration run-timing characteristics at Lower Granite of PIT-tagged wild yearling chinook salmon from Lemhi River.

	Detection Date												
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	# Parr Released	LWG PIT Counts	Adjusted PIT Counts	% Oberserved
1999	04/04	04/04	04/13	04/21	04/27	05/18	05/25	05/29	28	699	55	129.5	18.5
2000	04/11	04/11	04/12	04/13	04/16	05/07	05/09	06/01	25	468	41	78.4	16.8
2001	04/28	04/28	04/30	05/02	05/09	05/17	05/23	05/27	16	700	99	99.0	14.1
2002	04/14	04/14	04/15	04/15	04/30	05/19	05/22	05/23	35	700	26	60.6	8.7
2004	04/05	04/05	04/05	04/07	04/23	05/05	05/08	05/09	29	699	29	41.1	5.9

Figure B. 12: Historical outmigration run-timing at Lower Granite of PIT-tagged wild yearling chinook salmon from Lolo Creek.

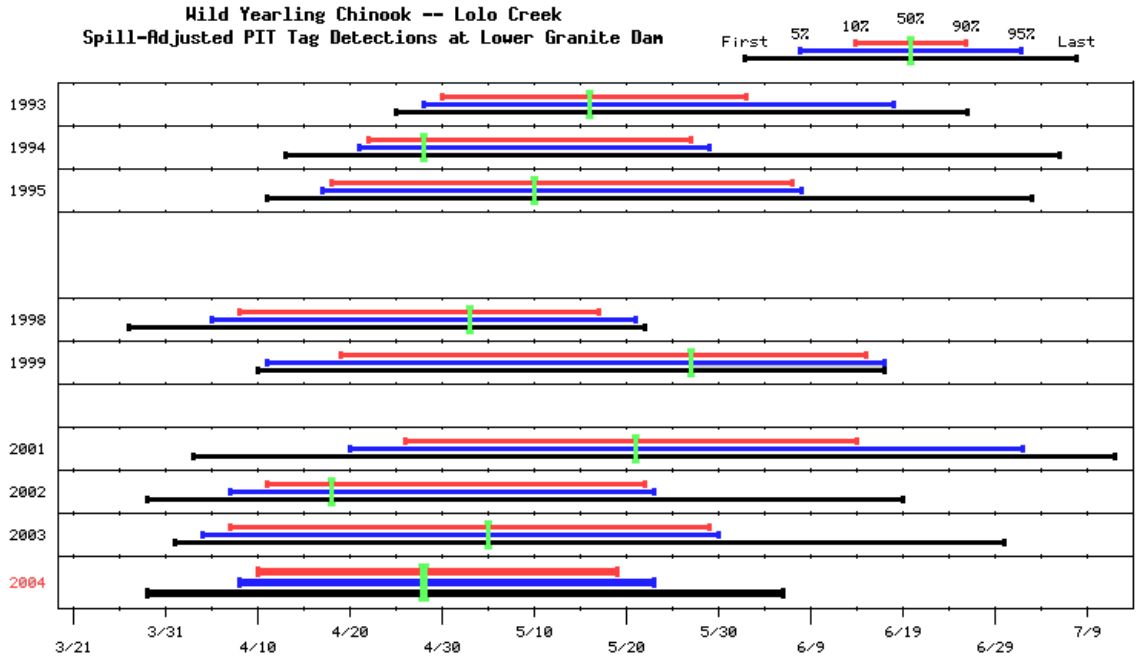


Table B. 12: Historical outmigration run-timing characteristics at Lower Granite of PIT-tagged wild yearling chinook salmon from Lolo Creek.

Detection Year	Detection Date								Middle 80% (days)	# Parr Released	LWG PIT Counts	Adjusted PIT Counts	% Oberserved
	First	1%	5%	10%	50%	90%	95%	Last					
1993	04/25	04/25	04/28	04/30	05/16	06/02	06/18	06/26	34	364	41	56.5	15.5
1994	04/13	04/18	04/21	04/22	04/28	05/27	05/29	07/06	36	1204	138	168.9	14.0
1995	04/11	04/11	04/17	04/18	05/10	06/07	06/08	07/03	51	766	61	78.2	10.2
1998	03/27	03/27	04/05	04/08	05/03	05/17	05/21	05/22	40	283	53	93.2	32.9
1999	04/10	04/10	04/11	04/19	05/27	06/15	06/17	06/17	58	856	38	92.4	10.8
2001	04/03	04/09	04/20	04/26	05/21	06/14	07/02	07/12	50	1203	198	198.0	16.5
2002	03/29	03/30	04/07	04/11	04/18	05/22	05/23	06/19	42	1932	75	166.8	8.6
2003	04/01	04/01	04/04	04/07	05/05	05/29	05/30	06/30	53	2005	62	122.1	6.1
2004	03/29	03/31	04/08	04/10	04/28	05/20	05/23	06/10	41	1570	179	229.1	14.6

Figure B. 13: Historical outmigration run-timing at Lower Granite of PIT-tagged wild yearling chinook salmon from Lookingglass Creek.

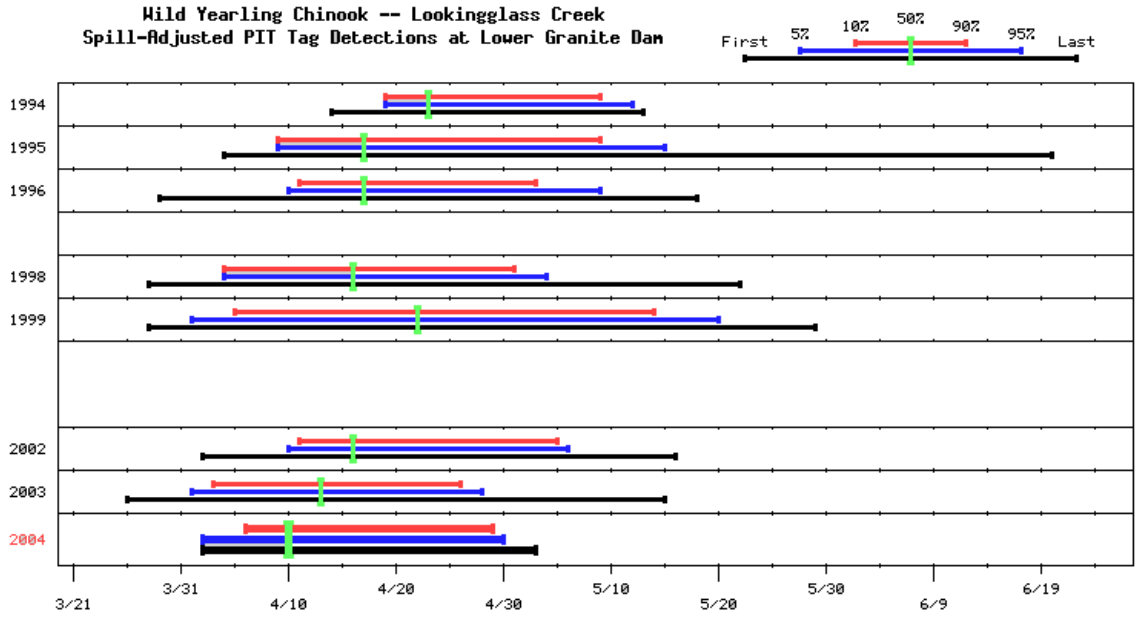


Table B. 13: Historical outmigration run-timing characteristics at Lower Granite of PIT-tagged wild yearling chinook salmon from Lookingglass Creek.

Detection Year	Detection Date								Middle 80% (days)	# Parr Released	LWG PIT Counts	Adjusted PIT Counts	% Oberserved
	First	1%	5%	10%	50%	90%	95%	Last					
1994	04/14	04/17	04/19	04/19	04/23	05/09	05/12	05/13	21	1159	131	135.1	11.7
1995	04/04	04/07	04/09	04/09	04/17	05/09	05/15	06/20	31	3146	244	275.0	8.7
1996	03/29	04/06	04/10	04/11	04/17	05/03	05/09	05/18	23	1794	110	304.1	16.9
1998	03/28	04/02	04/04	04/04	04/16	05/01	05/04	05/22	28	1383	181	287.8	20.8
1999	03/28	03/28	04/01	04/05	04/22	05/14	05/20	05/29	40	2270	111	245.7	10.8
2002	04/02	04/09	04/10	04/11	04/16	05/05	05/06	05/16	25	2185	71	157.8	7.2
2003	03/26	03/27	04/01	04/03	04/13	04/26	04/28	05/15	24	707	80	149.3	21.1
2004	04/02	04/02	04/02	04/06	04/10	04/29	04/30	05/03	24	289	16	28.3	9.8

Figure B. 14: Historical outmigration run-timing at Lower Granite of PIT-tagged wild yearling chinook salmon from Loon Creek.

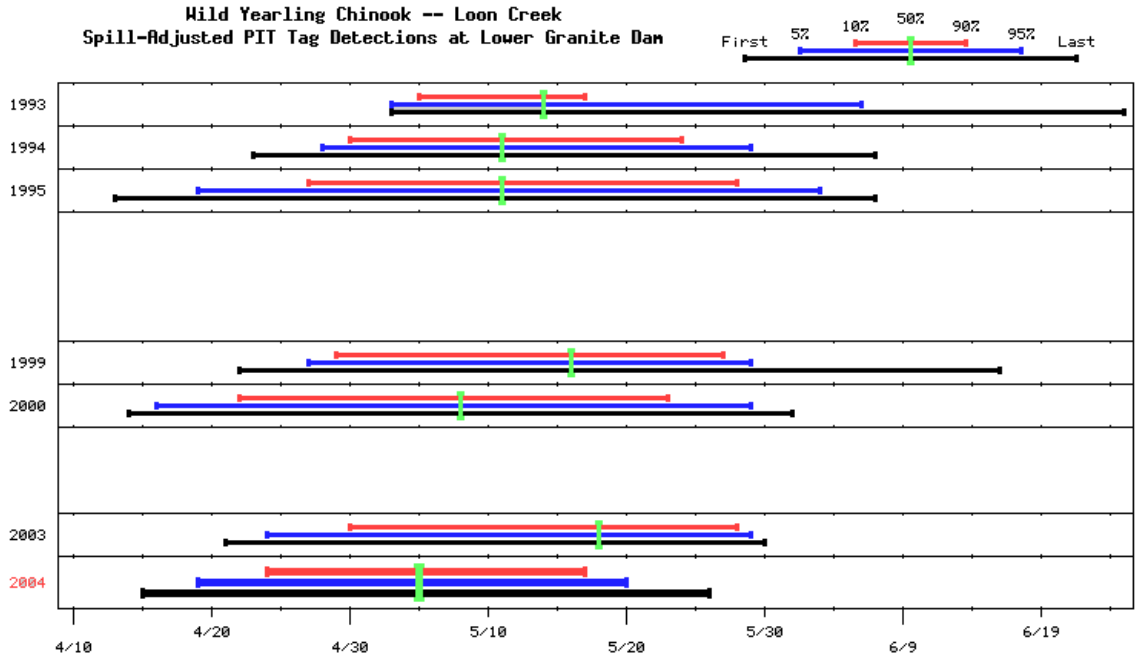


Table B. 14: Historical outmigration run-timing characteristics at Lower Granite of PIT-tagged wild yearling chinook salmon from Loon Creek.

Detection Year	Detection Date								Middle 80% (days)	# Parr Released	LWG PIT Counts	Adjusted PIT Counts	% Oberserved
	First	1%	5%	10%	50%	90%	95%	Last					
1993	05/03	05/03	05/03	05/05	05/14	05/17	06/06	06/25	13	261	24	35.3	13.5
1994	04/23	04/23	04/28	04/30	05/11	05/24	05/29	06/07	25	396	37	50.8	12.8
1995	04/13	04/13	04/19	04/27	05/11	05/28	06/03	06/07	32	964	83	117.8	12.2
1999	04/22	04/22	04/27	04/29	05/16	05/27	05/29	06/16	29	1029	71	173.4	16.9
2000	04/14	04/14	04/16	04/22	05/08	05/23	05/29	06/01	32	719	47	90.0	12.5
2003	04/21	04/21	04/24	04/30	05/18	05/28	05/29	05/30	29	830	61	129.4	15.6
2004	04/15	04/15	04/19	04/24	05/05	05/17	05/20	05/26	24	860	91	97.0	11.3

Figure B. 15: Historical outmigration run-timing at Lower Granite of PIT-tagged wild yearling chinook salmon from Lostine River.

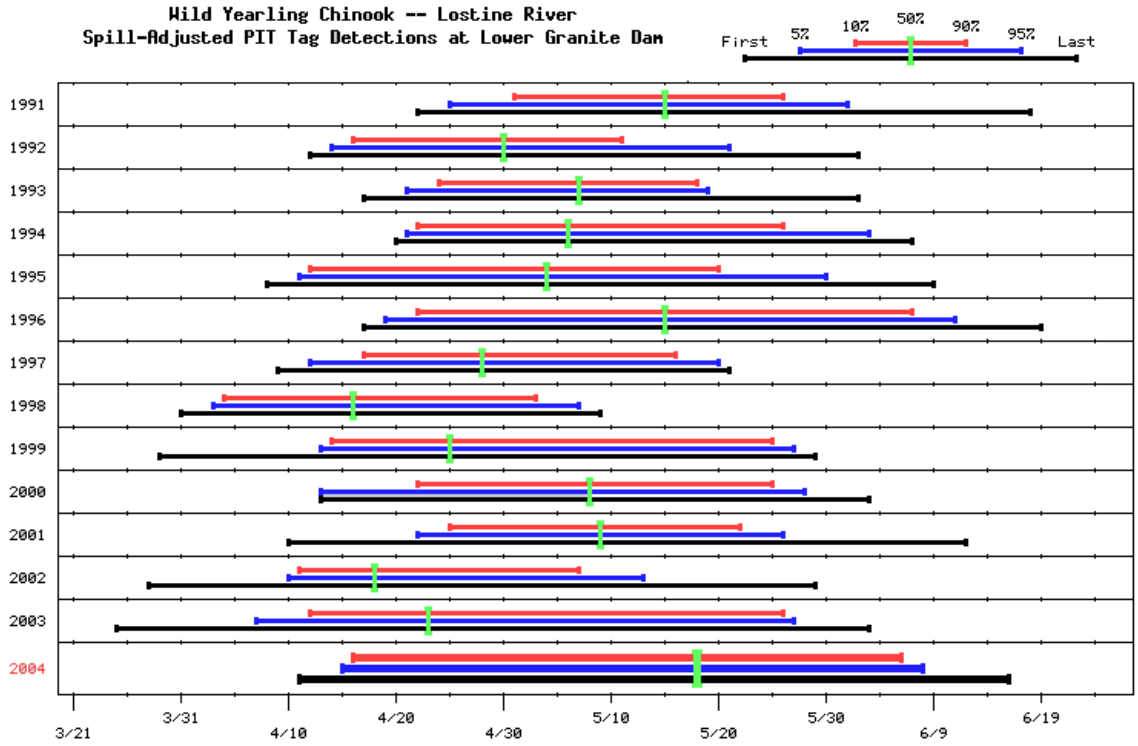


Table B. 15: Historical outmigration run-timing characteristics at Lower Granite of PIT-tagged wild yearling chinook salmon from Lostine River.

	Detection Date												
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	# Parr Released	LWG PIT Counts	Adjusted PIT Counts	% Oberserved
1991	04/22	04/22	04/25	05/01	05/15	05/26	06/01	06/18	26	549	51	51.8	9.4
1992	04/12	04/12	04/14	04/16	04/30	05/11	05/21	06/02	26	1107	92	92.0	8.3
1993	04/17	04/18	04/21	04/24	05/07	05/18	05/19	06/02	25	999	123	156.1	15.6
1994	04/20	04/20	04/21	04/22	05/06	05/26	06/03	06/07	35	725	71	87.4	12.1
1995	04/08	04/10	04/11	04/12	05/04	05/20	05/30	06/09	39	1002	112	142.0	14.2
1996	04/17	04/17	04/19	04/22	05/15	06/07	06/11	06/19	47	978	81	188.2	19.2
1997	04/09	04/09	04/12	04/17	04/28	05/16	05/20	05/21	30	527	43	93.0	17.6
1998	03/31	03/31	04/03	04/04	04/16	05/03	05/07	05/09	30	236	46	70.5	29.9
1999	03/29	03/30	04/13	04/14	04/25	05/25	05/27	05/29	42	823	44	106.6	13.0
2000	04/13	04/13	04/13	04/22	05/08	05/25	05/28	06/03	34	509	36	68.8	13.5
2001	04/10	04/10	04/22	04/25	05/09	05/22	05/26	06/12	28	489	87	87.0	17.8
2002	03/28	03/30	04/10	04/11	04/18	05/07	05/13	05/29	27	903	51	112.4	12.4
2003	03/25	04/03	04/07	04/12	04/23	05/26	05/27	06/03	45	1772	111	224.7	12.7
2004	04/11	04/11	04/15	04/16	05/18	06/06	06/08	06/18	52	992	89	110.0	11.1

Figure B. 16: Historical outmigration run-timing at Lower Granite of PIT-tagged wild yearling chinook salmon from Marsh Creek.

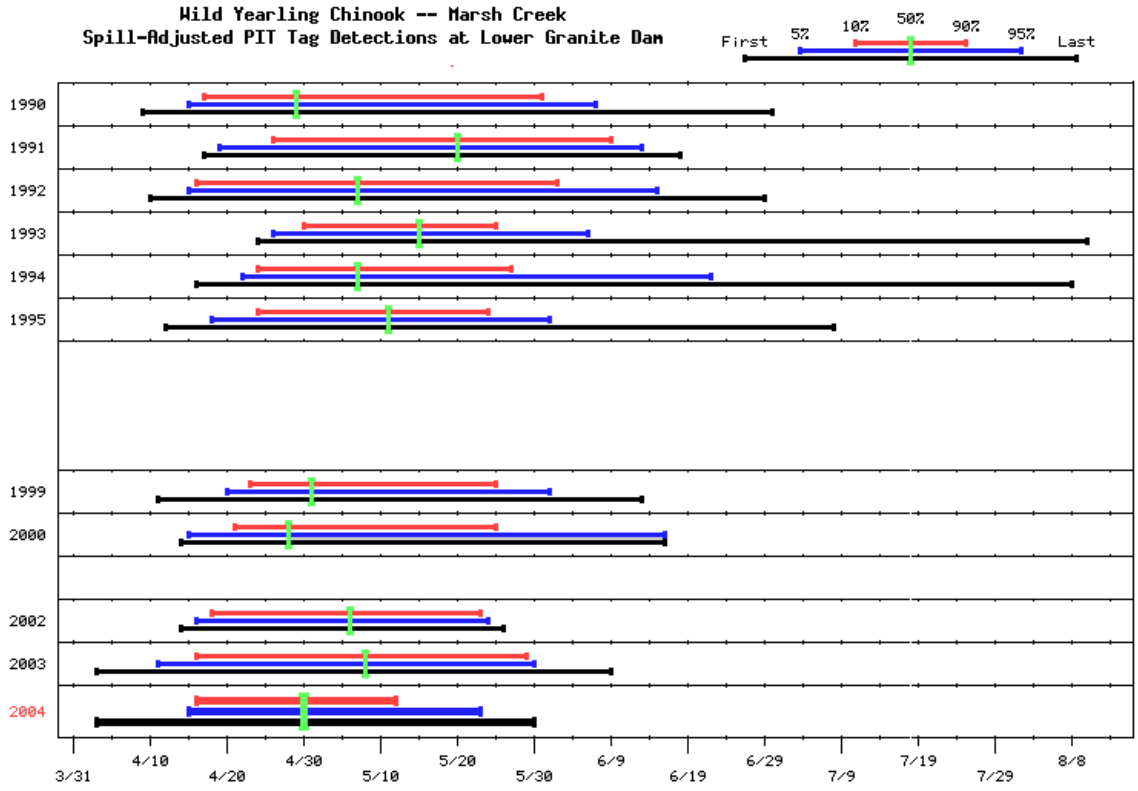


Table B. 16: Historical outmigration run-timing characteristics at Lower Granite of PIT-tagged wild yearling chinook salmon from Marsh Creek.

	Detection Date												
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	# Parr Released	LWG PIT Counts	Adjusted PIT Counts	% Oberserved
1990	04/09	04/12	04/15	04/17	04/29	05/31	06/07	06/30	45	2496	179	179.0	7.2
1991	04/17	04/17	04/19	04/26	05/20	06/09	06/13	06/18	45	861	59	59.0	6.9
1992	04/10	04/10	04/15	04/16	05/07	06/02	06/15	06/29	48	696	46	46.0	6.6
1993	04/24	04/25	04/26	04/30	05/15	05/25	06/06	08/10	26	1000	82	126.5	12.6
1994	04/16	04/16	04/22	04/24	05/07	05/27	06/22	08/08	34	944	75	90.8	9.6
1995	04/12	04/12	04/18	04/24	05/11	05/24	06/01	07/08	31	1095	68	94.8	8.7
1999	04/11	04/11	04/20	04/23	05/01	05/25	06/01	06/13	33	769	58	139.2	18.1
2000	04/14	04/14	04/15	04/21	04/28	05/25	06/16	06/16	35	554	23	46.6	8.4
2002	04/14	04/14	04/16	04/18	05/06	05/23	05/24	05/26	36	1056	42	89.8	8.5
2003	04/03	04/03	04/11	04/16	05/08	05/29	05/30	06/09	44	997	50	103.9	10.4
2004	04/03	04/03	04/15	04/16	04/30	05/12	05/23	05/30	27	1534	83	99.9	6.5

Figure B. 17: Historical outmigration run-timing at Lower Granite of PIT-tagged wild yearling chinook salmon from Minam River.

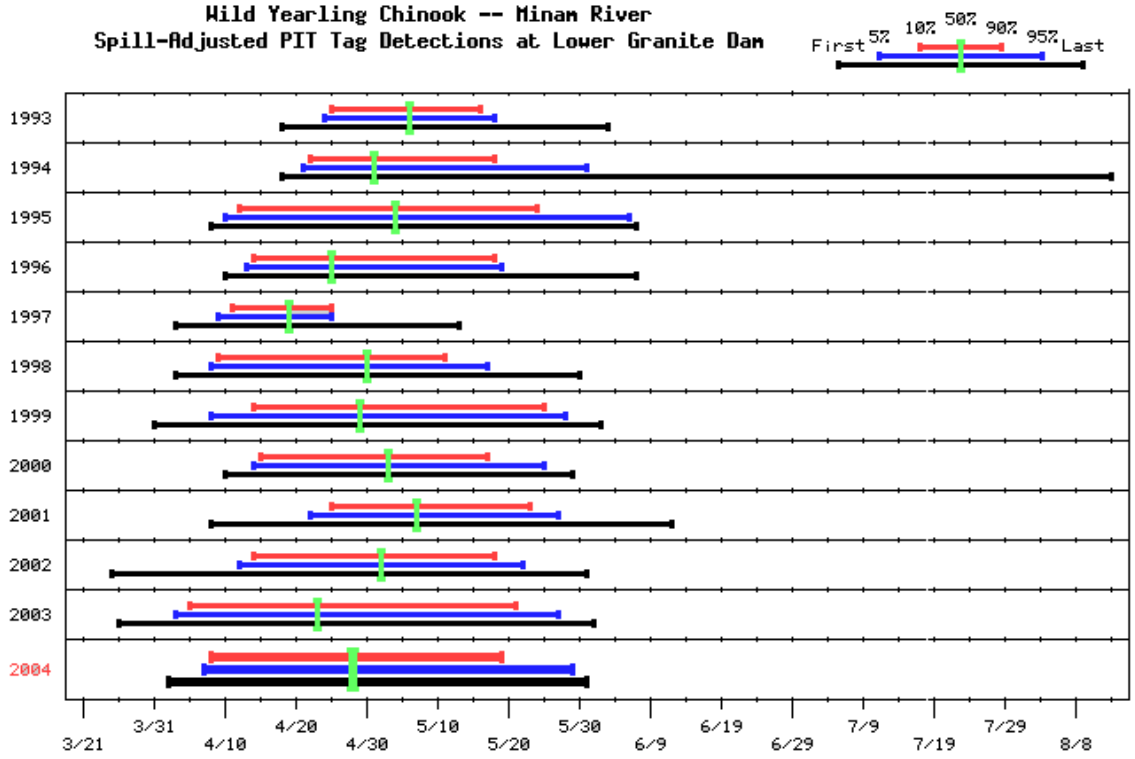


Table B. 17: Historical outmigration run-timing characteristics at Lower Granite of PIT-tagged wild yearling chinook salmon from Minam River.

	Detection Date												
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	# Parr Released	LWG PIT Counts	Adjusted PIT Counts	% Oberserved
1993	04/18	04/22	04/24	04/25	05/06	05/16	05/18	06/03	22	1000	105	125.5	12.5
1994	04/18	04/20	04/21	04/22	05/01	05/18	05/31	08/13	27	997	112	133.3	13.4
1995	04/08	04/08	04/10	04/12	05/04	05/24	06/06	06/07	43	996	70	89.3	9.0
1996	04/10	04/10	04/13	04/14	04/25	05/18	05/19	06/07	35	998	68	164.9	16.5
1997	04/03	04/03	04/09	04/11	04/19	04/25	04/25	05/13	15	589	49	92.4	15.7
1998	04/03	04/04	04/08	04/09	04/30	05/11	05/17	05/30	33	998	123	221.8	22.2
1999	03/31	04/03	04/08	04/14	04/29	05/25	05/28	06/02	42	1006	51	120.4	12.0
2000	04/10	04/10	04/14	04/15	05/03	05/17	05/25	05/29	33	998	74	142.1	14.2
2001	04/08	04/16	04/22	04/25	05/07	05/23	05/27	06/12	29	1000	178	178.0	17.8
2002	03/25	04/10	04/12	04/14	05/02	05/18	05/22	05/31	35	1533	65	149.9	9.8
2003	03/26	03/31	04/03	04/05	04/23	05/21	05/27	06/01	47	1598	81	159.2	10.0
2004	04/02	04/07	04/07	04/08	04/28	05/19	05/29	05/31	42	1397	82	100.0	7.2

Figure B. 18: Historical outmigration run-timing at Lower Granite of PIT-tagged wild yearling chinook salmon from South Fork Salmon River.

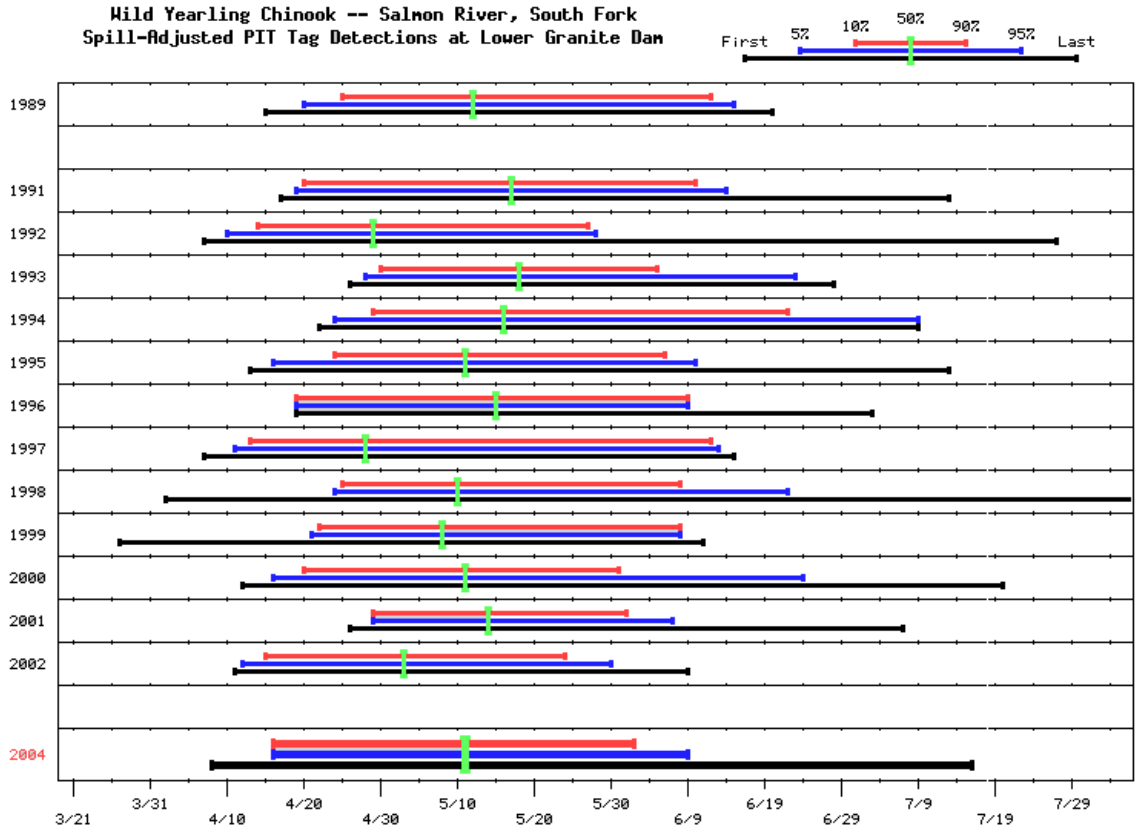


Table B. 18: Historical outmigration run-timing characteristics at Lower Granite of PIT-tagged wild yearling chinook salmon from South Fork Salmon River.

	Detection Date												
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	# Parr Released	LWG PIT Counts	Adjusted PIT Counts	% Oberserved
1989	04/15	04/15	04/20	04/25	05/12	06/12	06/15	06/20	49	2178	84	84.0	3.9
1991	04/17	04/17	04/19	04/20	05/17	06/10	06/14	07/13	52	986	98	98.8	10.0
1992	04/07	04/07	04/10	04/14	04/29	05/27	05/28	07/27	44	1027	81	81.0	7.9
1993	04/26	04/26	04/28	04/30	05/18	06/05	06/23	06/28	37	723	48	79.4	11.0
1994	04/22	04/22	04/24	04/29	05/16	06/22	07/09	07/09	55	803	41	58.1	7.2
1995	04/13	04/14	04/16	04/24	05/11	06/06	06/10	07/13	44	1571	78	105.2	6.7
1996	04/19	04/19	04/19	04/19	05/15	06/09	06/09	07/03	52	700	16	37.2	5.3
1997	04/07	04/07	04/11	04/13	04/28	06/12	06/13	06/15	61	700	36	78.9	11.3
1998	04/02	04/06	04/24	04/25	05/10	06/08	06/22	08/07	45	1007	83	155.5	15.4
1999	03/27	03/27	04/21	04/22	05/08	06/08	06/08	06/11	48	998	38	87.6	8.8
2000	04/12	04/12	04/16	04/20	05/11	05/31	06/24	07/20	42	1010	39	72.0	7.1
2001	04/26	04/26	04/29	04/29	05/14	06/01	06/07	07/07	34	1010	116	116.0	11.5
2002	04/11	04/11	04/12	04/15	05/03	05/24	05/30	06/09	40	1534	29	70.1	4.6
2004	04/08	04/08	04/16	04/16	05/11	06/02	06/09	07/16	48	1490	73	86.0	5.8

Figure B. 19: Historical outmigration run-timing at Lower Granite of PIT-tagged wild yearling chinook salmon from Secesh River.

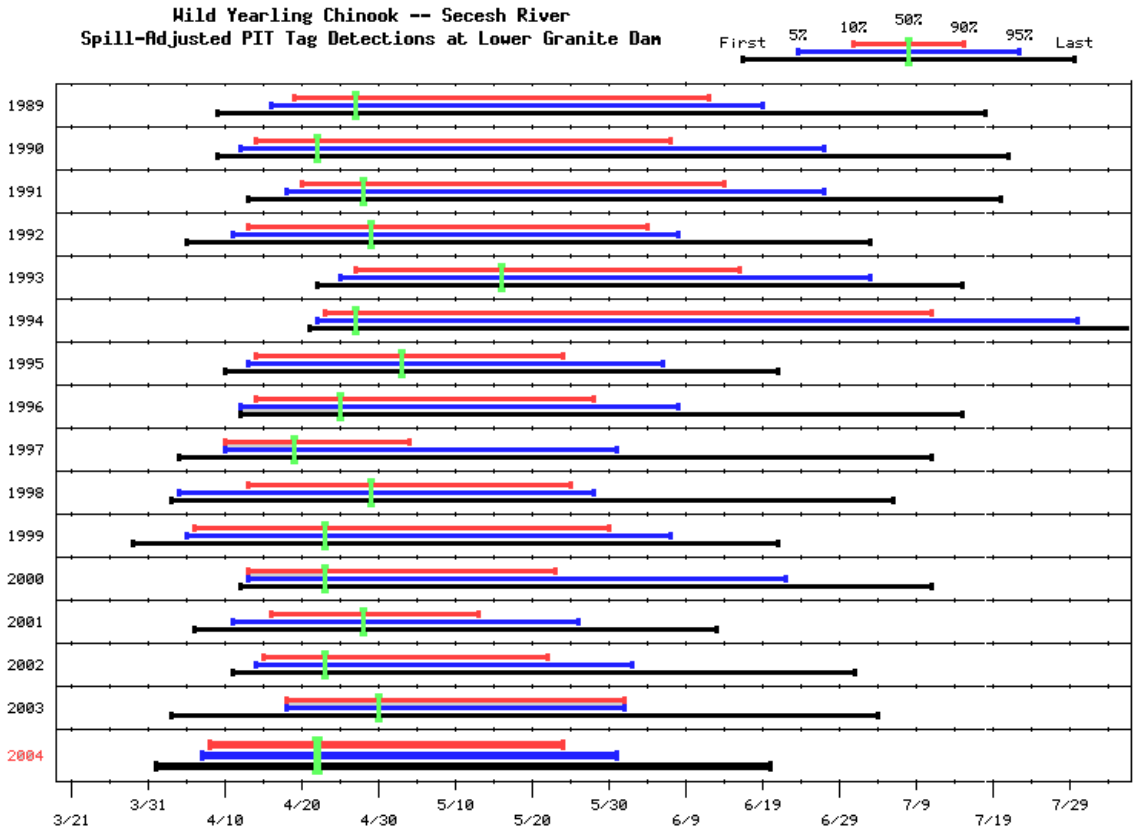


Table B. 19: Historical outmigration run-timing characteristics at Lower Granite of PIT-tagged wild yearling chinook salmon from Secesh River.

	Detection Date												
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	# Parr Released	LWG PIT Counts	Adjusted PIT Counts	% Oberserved
1989	04/09	04/12	04/16	04/19	04/27	06/12	06/19	07/18	55	1507	142	142.0	9.4
1990	04/09	04/10	04/12	04/14	04/22	06/07	06/27	07/21	55	1545	108	108.0	7.0
1991	04/13	04/13	04/18	04/20	04/28	06/14	06/27	07/20	56	1016	71	72.3	7.1
1992	04/05	04/05	04/11	04/13	04/29	06/04	06/08	07/03	53	1012	40	40.0	4.0
1993	04/22	04/22	04/25	04/27	05/16	06/16	07/03	07/15	51	327	30	37.0	11.3
1994	04/21	04/21	04/22	04/23	04/27	07/11	07/30	08/07	80	422	32	33.0	7.8
1995	04/10	04/10	04/13	04/14	05/03	05/24	06/06	06/21	41	1213	74	90.6	7.5
1996	04/12	04/12	04/12	04/14	04/25	05/28	06/08	07/15	45	571	26	70.0	12.3
1997	04/04	04/04	04/10	04/10	04/19	05/04	05/31	07/11	25	260	34	62.7	24.1
1998	04/03	04/03	04/04	04/13	04/29	05/25	05/28	07/06	43	588	74	126.1	21.4
1999	03/29	03/29	04/05	04/06	04/23	05/30	06/07	06/21	55	936	36	80.4	8.6
2000	04/12	04/12	04/13	04/13	04/23	05/23	06/22	07/11	41	907	40	74.2	8.2
2001	04/06	04/06	04/11	04/16	04/28	05/13	05/26	06/13	28	586	169	169.0	28.8
2002	04/11	04/12	04/14	04/15	04/23	05/22	06/02	07/01	38	4285	150	353.4	8.2
2003	04/03	04/03	04/18	04/18	04/30	06/01	06/01	07/04	45	1040	16	31.7	3.0
2004	04/01	04/03	04/07	04/08	04/23	05/24	06/06	06/20	47	3068	148	213.8	7.0

Figure B. 20: Historical outmigration run-timing at Lower Granite of PIT-tagged wild yearling chinook salmon from Sulfur Creek.

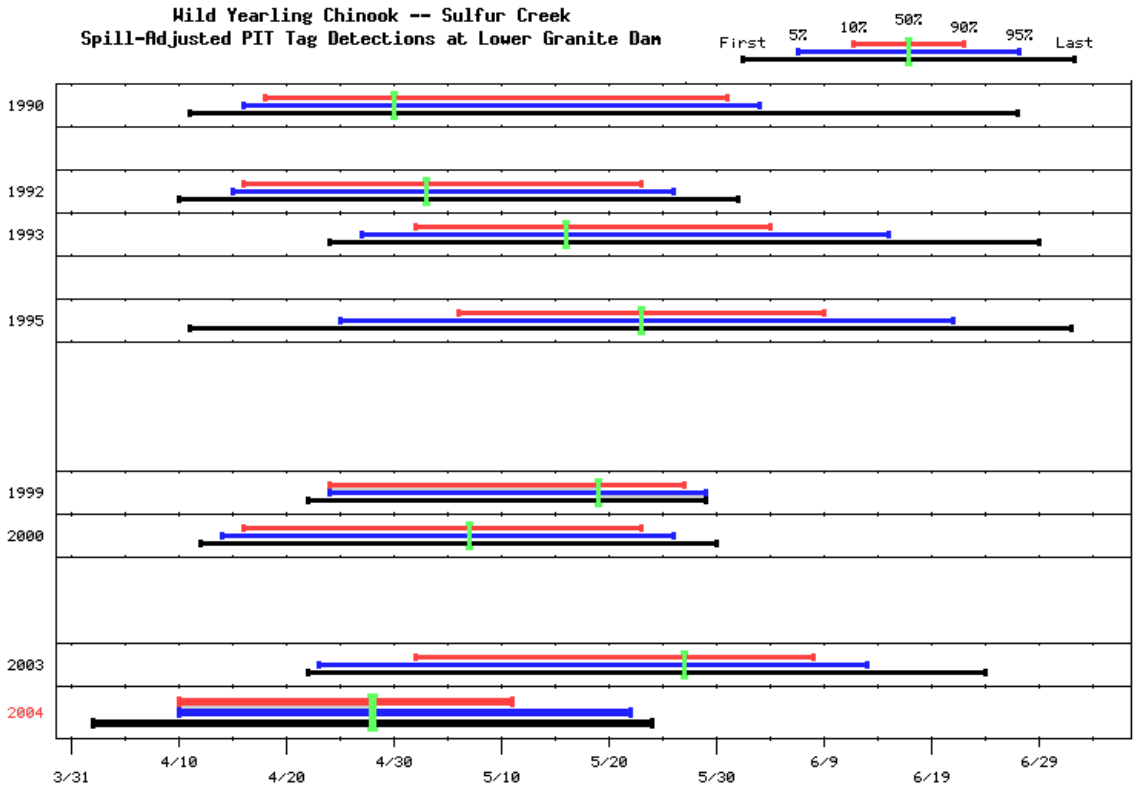


Table B. 20: Historical outmigration run-timing characteristics at Lower Granite of PIT-tagged wild yearling chinook salmon from Sulfur Creek.

	Detection Date												
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	# Parr Released	LWG PIT Counts	Adjusted PIT Counts	% Oberserved
1990	04/11	04/11	04/16	04/18	04/30	05/31	06/03	06/27	44	1043	83	83.0	8.0
1992	04/10	04/10	04/15	04/16	05/03	05/23	05/26	06/01	38	210	24	24.0	11.4
1993	04/24	04/24	04/27	05/02	05/16	06/04	06/15	06/29	34	712	28	41.6	5.8
1995	04/11	04/11	04/25	05/06	05/23	06/09	06/21	07/02	35	728	56	80.2	11.0
1999	04/22	04/22	04/24	04/24	05/19	05/27	05/29	05/29	34	443	17	42.1	9.5
2000	04/12	04/12	04/14	04/16	05/07	05/23	05/26	05/30	38	838	52	99.0	11.8
2003	04/22	04/22	04/23	05/02	05/27	06/08	06/13	06/24	38	560	25	50.4	9.0
2004	04/02	04/02	04/10	04/10	04/28	05/11	05/22	05/24	32	1049	26	31.4	3.0

Figure B. 21: Historical outmigration run-timing at Lower Granite of PIT-tagged wild yearling chinook salmon from Valley Creek.

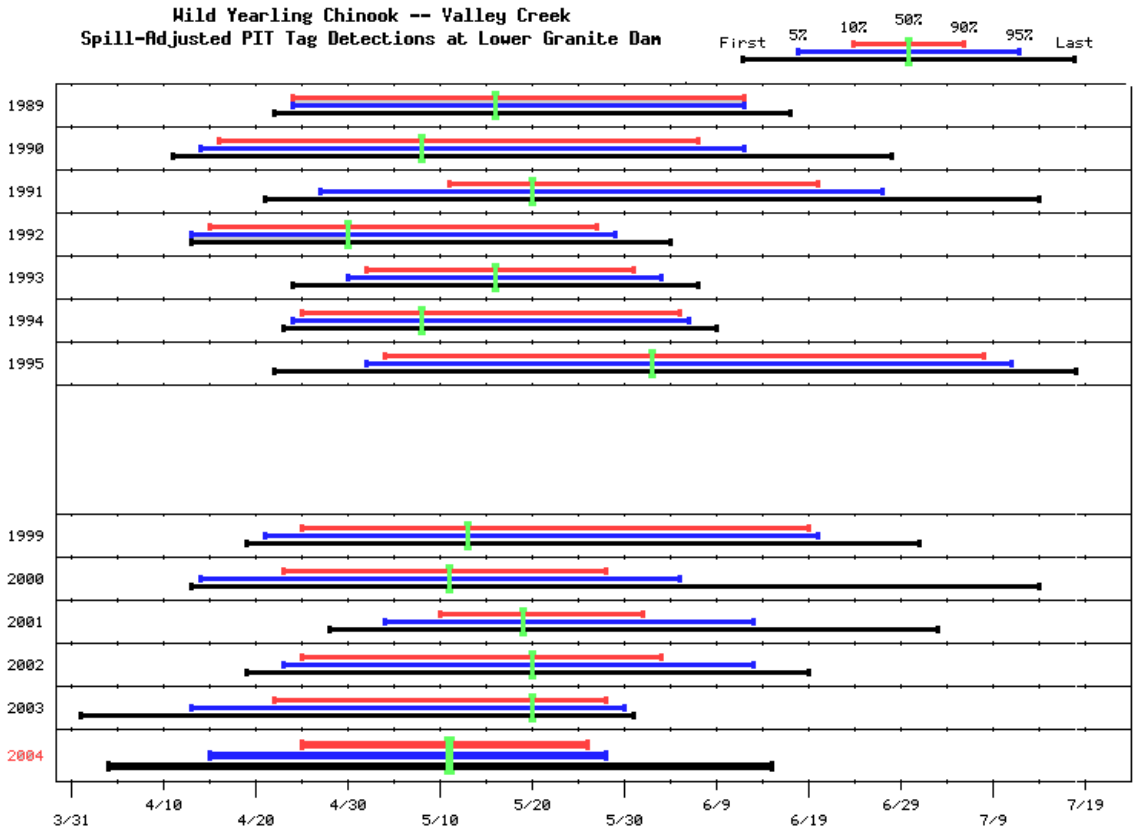


Table B. 21: Historical outmigration run-timing characteristics at Lower Granite of PIT-tagged wild yearling chinook salmon from Valley Creek.

	Detection Date												
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	# Parr Released	LWG PIT Counts	Adjusted PIT Counts	% Oberserved
1989	04/22	04/22	04/24	04/24	05/16	06/12	06/12	06/17	50	1241	43	43.0	3.5
1990	04/11	04/11	04/14	04/16	05/08	06/07	06/12	06/28	53	2496	76	76.0	3.0
1991	04/21	04/21	04/27	05/11	05/20	06/20	06/27	07/14	41	1024	41	41.0	4.0
1992	04/13	04/13	04/13	04/15	04/30	05/27	05/29	06/04	43	969	34	34.0	3.5
1993	04/24	04/24	04/30	05/02	05/16	05/31	06/03	06/07	30	1026	32	51.2	5.0
1994	04/23	04/23	04/24	04/25	05/08	06/05	06/06	06/09	42	848	45	61.8	7.3
1995	04/22	04/22	05/02	05/04	06/02	07/08	07/11	07/18	66	1551	50	64.0	4.1
1999	04/19	04/19	04/21	04/25	05/13	06/19	06/20	07/01	56	1001	50	118.3	11.8
2000	04/13	04/13	04/14	04/23	05/11	05/28	06/05	07/14	36	1009	51	95.7	9.5
2001	04/28	04/30	05/04	05/10	05/19	06/01	06/13	07/03	23	1004	135	135.0	13.4
2002	04/19	04/19	04/23	04/25	05/20	06/03	06/13	06/19	40	1497	41	89.8	6.0
2003	04/01	04/02	04/13	04/22	05/20	05/28	05/30	05/31	37	2266	50	104.2	4.6
2004	04/04	04/04	04/15	04/25	05/11	05/26	05/28	06/15	32	2498	108	116.6	4.7

Figure B. 22: Historical outmigration run-timing at Lower Granite of the CRiSP composite of PIT-tagged wild yearling chinook salmon.

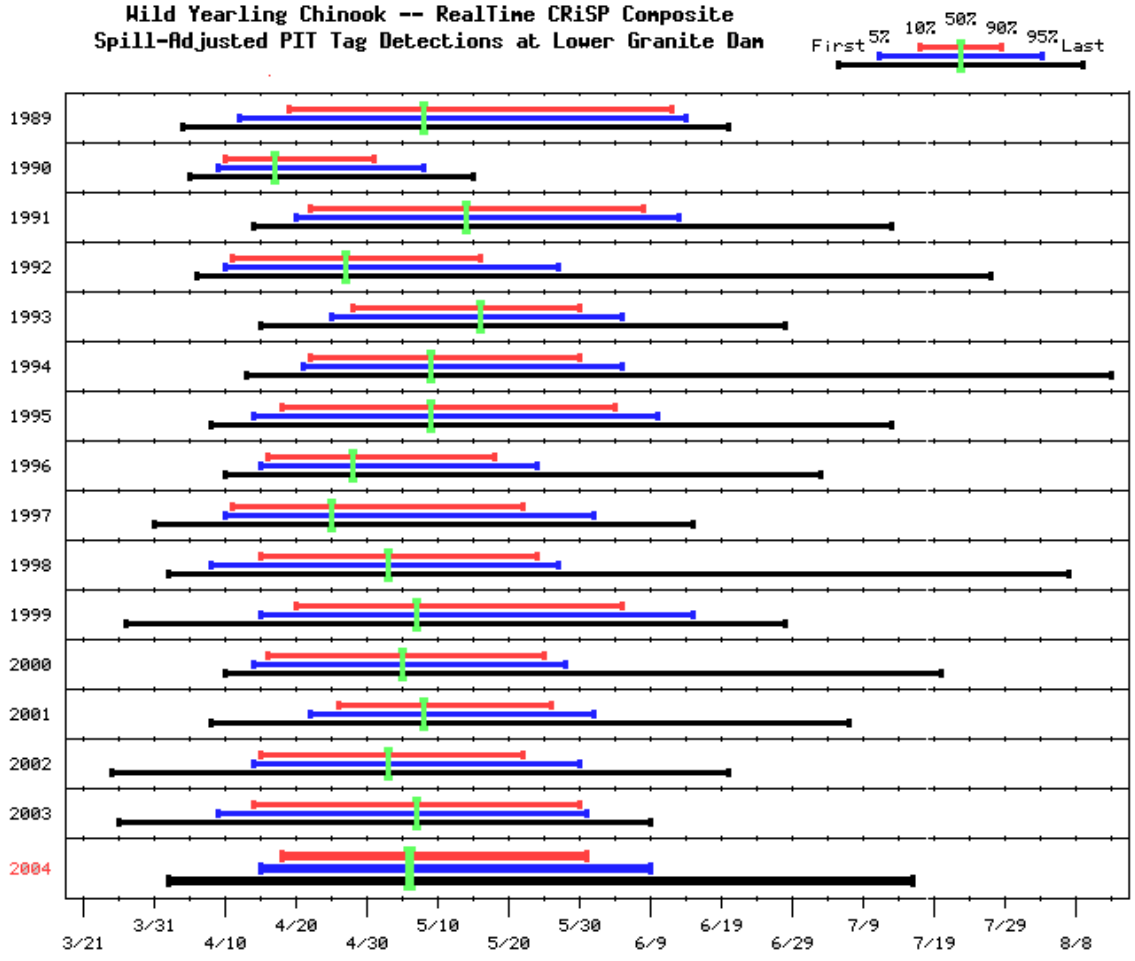


Table B. 22: Historical outmigration run-timing characteristics at Lower Granite of the CRiSP composite of PIT-tagged wild yearling chinook salmon.

	Detection Date												
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	# Parr Released	LWG PIT Counts	Adjusted PIT Counts	% Oberserved
1989	04/04	04/05	04/12	04/19	05/08	06/12	06/14	06/20	55	2766	120	120.0	4.3
1990	04/05	04/05	04/09	04/10	04/17	05/01	05/08	05/15	22	897	69	69.0	7.7
1991	04/14	04/17	04/20	04/22	05/14	06/08	06/13	07/13	48	2325	193	194.7	8.4
1992	04/06	04/06	04/10	04/11	04/27	05/16	05/27	07/27	36	2725	221	221.0	8.1
1993	04/15	04/21	04/25	04/28	05/16	05/30	06/05	06/28	33	3819	318	451.5	11.8
1994	04/13	04/16	04/21	04/22	05/09	05/30	06/05	08/13	39	3967	320	406.1	10.2
1995	04/08	04/10	04/14	04/18	05/09	06/04	06/10	07/13	48	4864	303	399.1	8.2
1996	04/10	04/12	04/15	04/16	04/28	05/18	05/24	07/03	33	3194	221	521.7	16.3
1997	03/31	04/06	04/10	04/11	04/25	05/22	06/01	06/15	42	2891	234	482.6	16.7
1998	04/02	04/04	04/08	04/15	05/03	05/24	05/27	08/07	40	3515	408	752.2	21.4
1999	03/27	03/31	04/15	04/20	05/07	06/05	06/15	06/28	47	3962	174	413.6	10.4
2000	04/10	04/11	04/14	04/16	05/05	05/25	05/28	07/20	40	3489	206	390.9	11.2
2001	04/08	04/11	04/22	04/26	05/08	05/26	06/01	07/07	31	3511	486	486.0	13.8
2002	03/25	04/11	04/14	04/15	05/03	05/22	05/30	06/20	38	5038	145	335.7	6.7
2003	03/26	04/03	04/09	04/14	05/07	05/30	05/31	06/09	47	5102	223	464.2	9.1
2004	04/02	04/07	04/15	04/18	05/06	05/31	06/09	07/16	44	5225	342	401.3	7.7

Figure B. 23: Historical outmigration run-timing at Lower Granite of a composite of PIT-tagged wild yearling chinook salmon from the Snake River drainage.

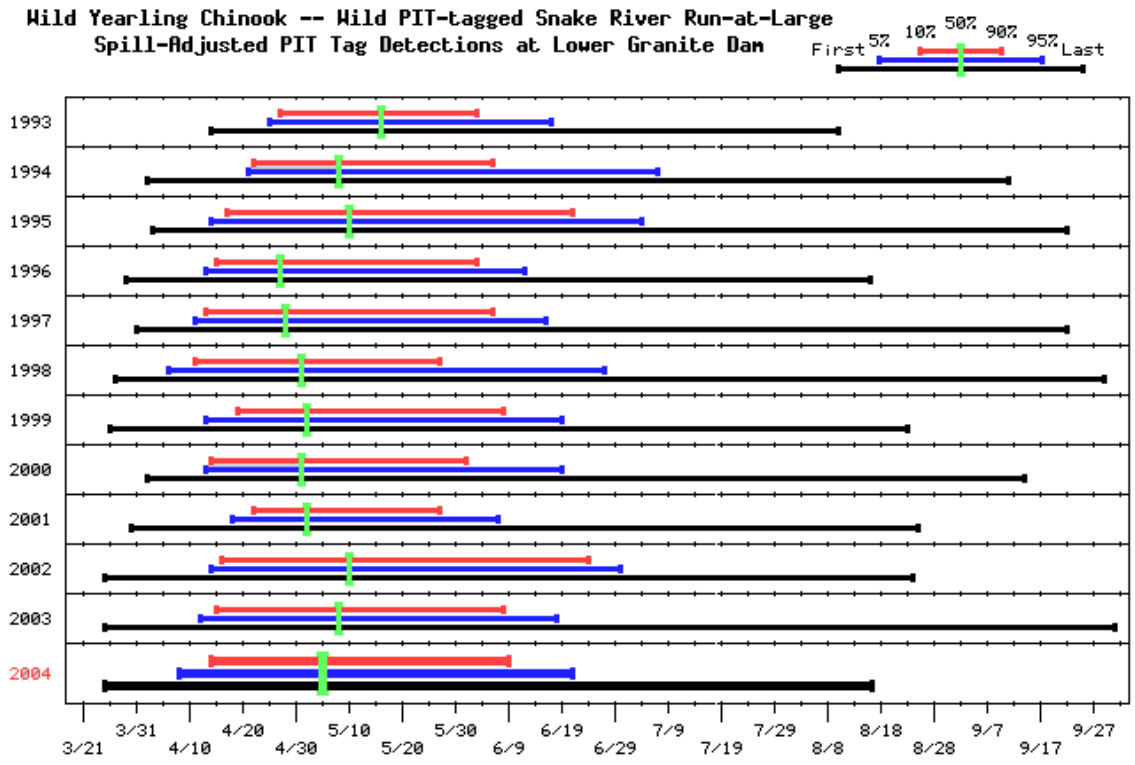


Table B. 23: Historical outmigration run-timing characteristics at Lower Granite of a composite of PIT-tagged wild yearling chinook salmon from the Snake River drainage.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total LGR Passage
1993	04/14	04/21	04/25	04/27	05/16	06/03	06/17	08/10	38	3939
1994	04/02	04/19	04/21	04/22	05/08	06/06	07/07	09/11	46	6889
1995	04/03	04/10	04/14	04/17	05/10	06/21	07/04	09/22	66	9437
1996	03/29	04/11	04/13	04/15	04/27	06/03	06/12	08/16	50	5418
1997	03/31	04/07	04/11	04/13	04/28	06/06	06/16	09/22	55	2497
1998	03/27	04/03	04/06	04/11	05/01	05/27	06/27	09/29	47	13425
1999	03/26	04/02	04/13	04/19	05/02	06/08	06/19	08/23	51	17945
2000	04/02	04/10	04/13	04/14	05/01	06/01	06/19	09/14	49	14541
2001	03/30	04/11	04/18	04/22	05/02	05/27	06/07	08/25	36	18076
2002	03/25	04/10	04/14	04/16	05/10	06/24	06/30	08/24	70	11504
2003	03/25	04/03	04/12	04/15	05/08	06/08	06/18	10/01	55	20782
2004	03/25	04/03	04/08	04/13	05/05	06/09	06/20	08/17	58	23812

Figure B. 24: Historical outmigration run-timing at McNary of a composite of PIT-tagged wild yearling chinook salmon from the Snake River drainage.

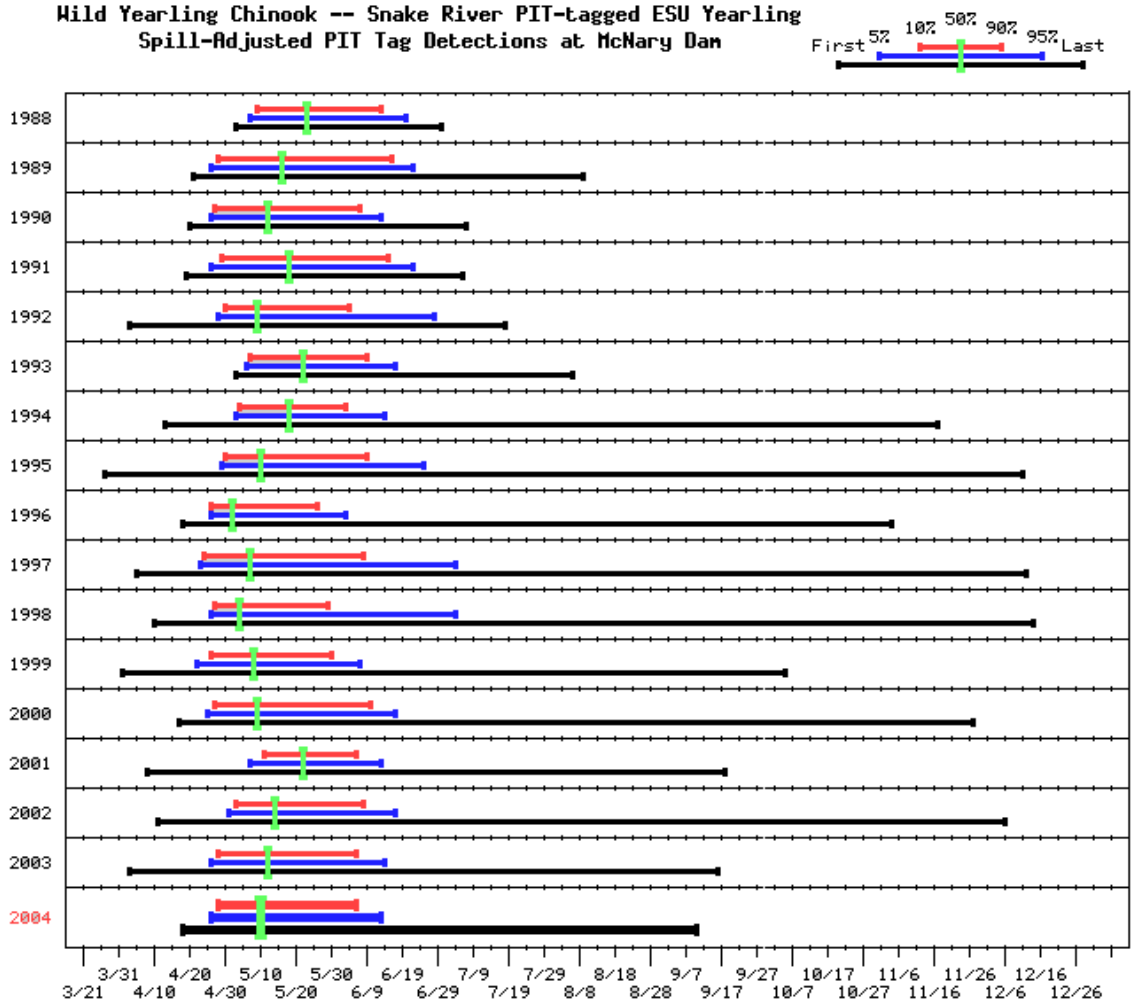


Table B. 24: Historical outmigration run-timing characteristics at McNary of a composite of PIT-tagged wild yearling chinook salmon from the Snake River drainage.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total MCN Passage
1988	05/03	05/03	05/07	05/09	05/23	06/13	06/20	06/30	36	58
1989	04/21	04/22	04/26	04/28	05/16	06/16	06/22	08/09	50	281
1990	04/20	04/24	04/26	04/27	05/12	06/07	06/13	07/07	42	213
1991	04/19	04/22	04/26	04/29	05/18	06/15	06/22	07/06	48	204
1992	04/03	04/23	04/28	04/30	05/09	06/04	06/28	07/18	36	307
1993	05/03	05/04	05/06	05/07	05/22	06/09	06/17	08/06	34	1410
1994	04/13	05/01	05/03	05/04	05/18	06/03	06/14	11/17	31	6154
1995	03/27	04/24	04/29	04/30	05/10	06/09	06/25	12/11	41	20689
1996	04/18	04/20	04/26	04/26	05/02	05/26	06/03	11/04	31	4524
1997	04/05	04/16	04/23	04/24	05/07	06/08	07/04	12/12	46	676
1998	04/10	04/24	04/26	04/27	05/04	05/29	07/04	12/14	33	11126
1999	04/01	04/18	04/22	04/26	05/08	05/30	06/07	10/05	35	22487
2000	04/17	04/22	04/25	04/27	05/09	06/10	06/17	11/27	45	24905
2001	04/08	05/03	05/07	05/11	05/22	06/06	06/13	09/18	27	8782
2002	04/11	04/25	05/01	05/03	05/14	06/08	06/17	12/06	37	18244
2003	04/03	04/23	04/26	04/28	05/12	06/06	06/14	09/16	40	24878
2004	04/18	04/21	04/26	04/28	05/10	06/06	06/13	09/10	40	13622

Figure B. 25: Historical outmigration run-timing at Lower Granite of PIT-tagged wild steelhead trout from the Snake River drainage.

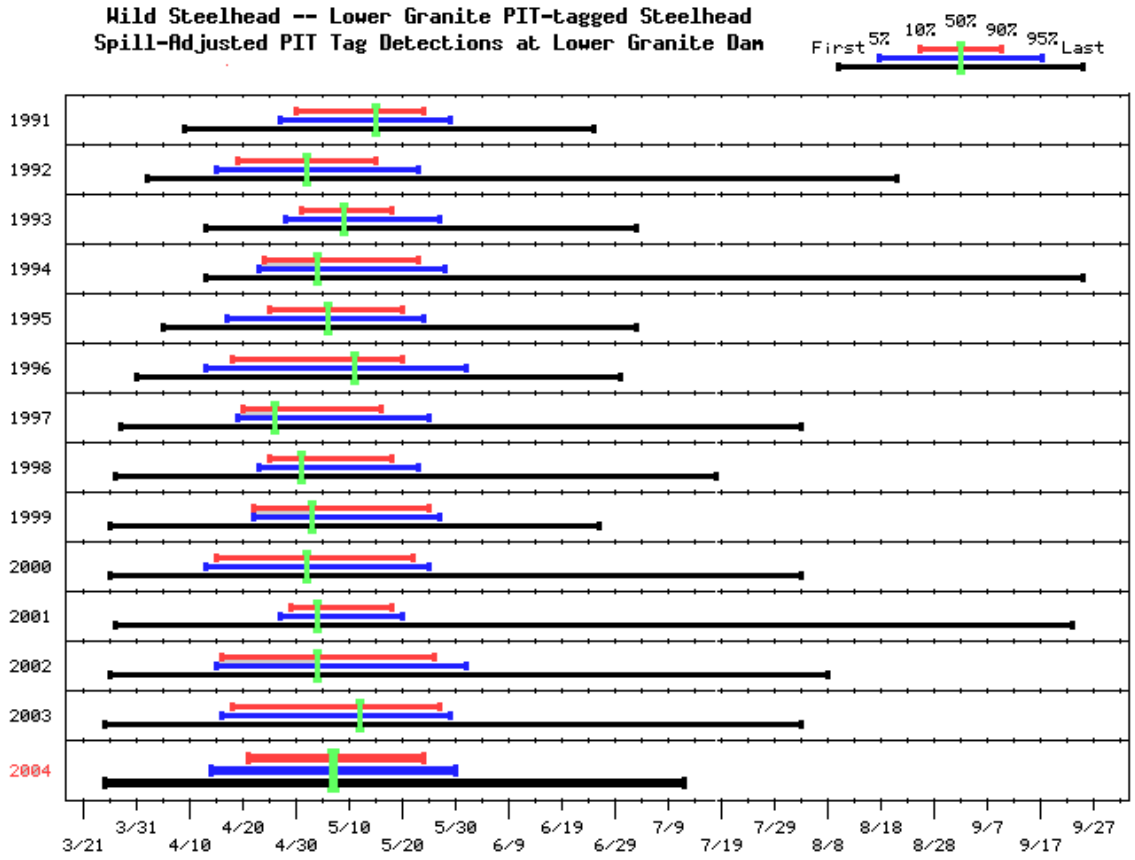


Table B. 25: Historical outmigration run-timing characteristics at Lower Granite of PIT-tagged wild steelhead trout from the Snake River drainage.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total LGR Passage
1991	04/09	04/18	04/27	04/30	05/15	05/24	05/29	06/25	25	2914
1992	04/02	04/10	04/15	04/19	05/02	05/15	05/23	08/21	27	3638
1993	04/13	04/20	04/28	05/01	05/09	05/18	05/27	07/03	18	4757
1994	04/13	04/21	04/23	04/24	05/04	05/23	05/28	09/25	30	5346
1995	04/05	04/12	04/17	04/25	05/06	05/20	05/24	07/03	26	4458
1996	03/31	04/11	04/13	04/18	05/11	05/20	06/01	06/30	33	3966
1997	03/28	04/06	04/19	04/20	04/26	05/16	05/25	08/03	27	4459
1998	03/27	04/05	04/23	04/25	05/01	05/18	05/23	07/18	24	8522
1999	03/26	04/03	04/22	04/22	05/03	05/25	05/27	06/26	34	6988
2000	03/26	04/08	04/13	04/15	05/02	05/22	05/25	08/03	38	13604
2001	03/27	04/22	04/27	04/29	05/04	05/18	05/20	09/23	20	13570
2002	03/26	04/12	04/15	04/16	05/04	05/26	06/01	08/08	41	10274
2003	03/25	04/04	04/16	04/18	05/12	05/27	05/29	08/03	40	10466
2004	03/25	04/04	04/14	04/22	05/07	05/24	05/30	07/24	33	12783

Figure B. 26: Historical outmigration run-timing at McNary of PIT-tagged wild steelhead trout from the Snake River drainage.

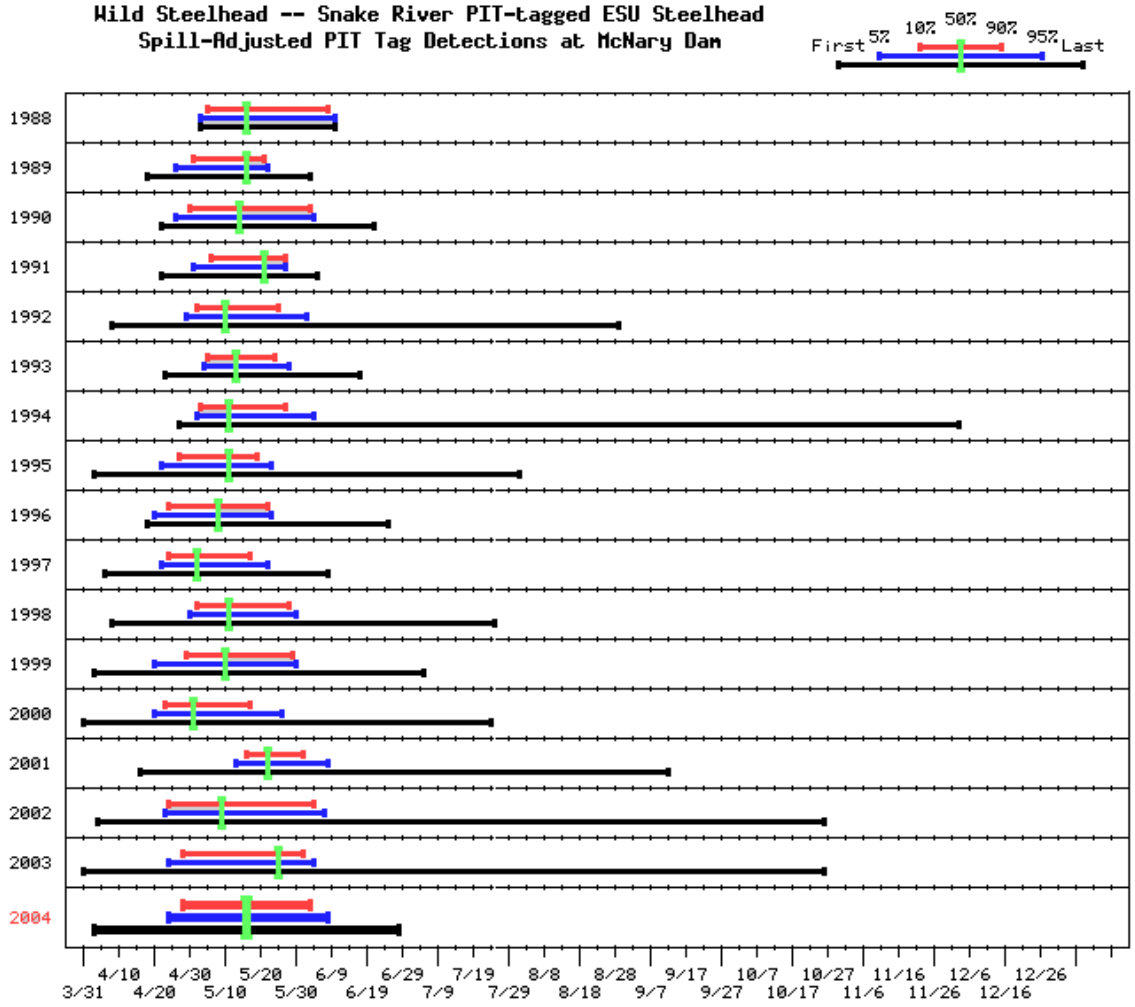


Table B. 26: Historical outmigration run-timing characteristics at McNary of PIT-tagged wild steelhead trout from the Snake River drainage.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total MCN Passage
1988	05/03	05/03	05/03	05/05	05/16	06/08	06/10	06/10	35	18
1989	04/18	04/22	04/26	05/01	05/16	05/21	05/22	06/03	21	166
1990	04/22	04/23	04/26	04/30	05/14	06/03	06/04	06/21	35	119
1991	04/22	04/26	05/01	05/06	05/21	05/27	05/27	06/05	22	160
1992	04/08	04/22	04/29	05/02	05/10	05/25	06/02	08/29	24	479
1993	04/23	05/01	05/04	05/05	05/13	05/24	05/28	06/17	20	910
1994	04/27	05/01	05/02	05/03	05/11	05/27	06/04	12/03	25	1945
1995	04/03	04/08	04/22	04/27	05/11	05/19	05/23	08/01	23	1416
1996	04/18	04/18	04/20	04/24	05/08	05/22	05/23	06/25	29	1117
1997	04/06	04/09	04/22	04/24	05/02	05/17	05/22	06/08	24	1156
1998	04/08	04/19	04/30	05/02	05/11	05/28	05/30	07/25	27	2674
1999	04/03	04/12	04/20	04/29	05/10	05/29	05/30	07/05	31	4955
2000	03/31	04/16	04/20	04/23	05/01	05/17	05/26	07/24	25	12093
2001	04/16	05/07	05/13	05/16	05/22	06/01	06/08	09/12	17	2641
2002	04/04	04/18	04/23	04/24	05/09	06/04	06/07	10/26	42	10426
2003	03/31	04/12	04/24	04/28	05/25	06/01	06/04	10/26	35	6369
2004	04/03	04/18	04/24	04/28	05/16	06/03	06/08	06/28	37	2613

Figure B. 27: Historical outmigration run-timing at McNary of PIT-tagged wild steelhead trout from the Upper Columbia River.

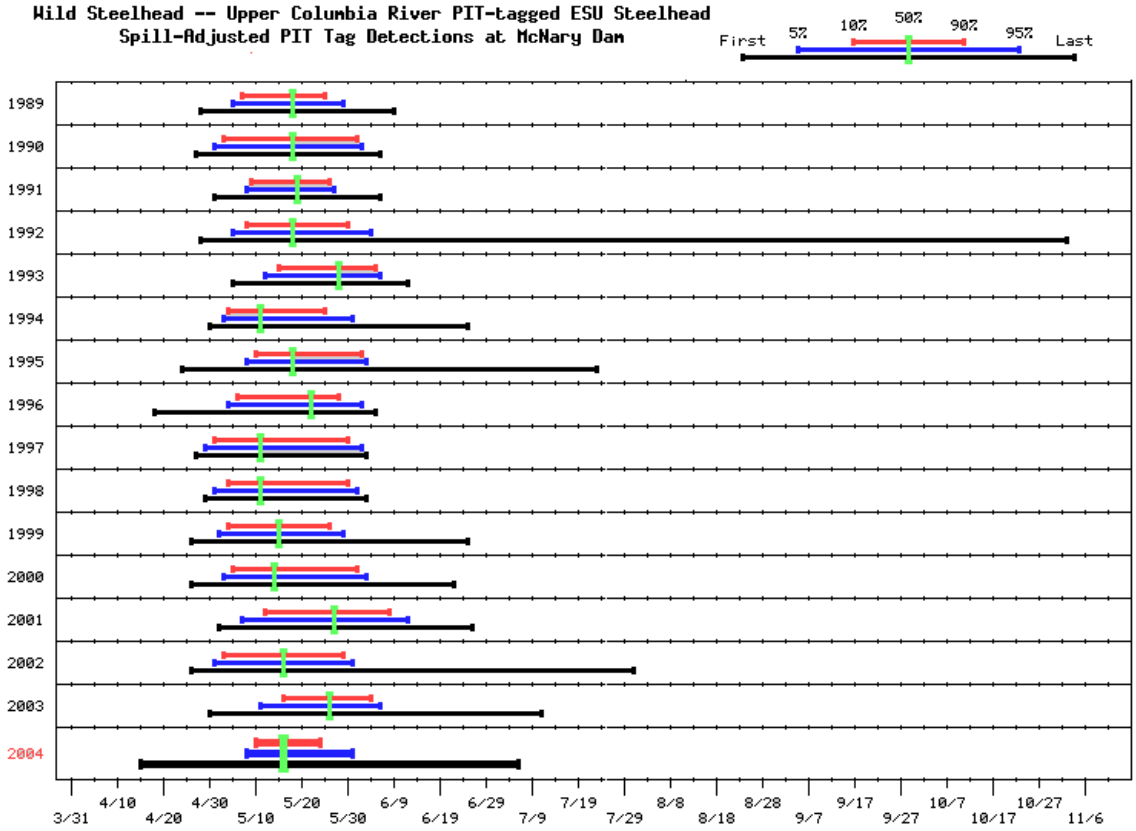


Table B. 27: Historical outmigration run-timing characteristics at McNary of PIT-tagged wild steelhead trout from the Upper Columbia River.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total MCN Passage
1989	04/28	05/03	05/05	05/07	05/18	05/25	05/29	06/09	19	262
1990	04/27	04/28	05/01	05/03	05/18	06/01	06/02	06/06	30	279
1991	05/01	05/05	05/08	05/09	05/19	05/26	05/27	06/06	18	352
1992	04/28	05/02	05/05	05/08	05/18	05/30	06/04	11/02	23	397
1993	05/05	05/07	05/12	05/15	05/28	06/05	06/06	06/12	22	144
1994	04/30	05/01	05/03	05/04	05/11	05/25	05/31	06/25	22	367
1995	04/24	05/07	05/08	05/10	05/18	06/02	06/03	07/23	24	251
1996	04/18	05/02	05/04	05/06	05/22	05/28	06/02	06/05	23	261
1997	04/27	04/27	04/29	05/01	05/11	05/30	06/02	06/03	30	193
1998	04/29	04/30	05/01	05/04	05/11	05/30	06/01	06/03	27	206
1999	04/26	04/28	05/02	05/04	05/15	05/26	05/29	06/25	23	9615
2000	04/26	04/30	05/03	05/05	05/14	06/01	06/03	06/22	28	5240
2001	05/02	05/03	05/07	05/12	05/27	06/08	06/12	06/26	28	191
2002	04/26	04/28	05/01	05/03	05/16	05/29	05/31	07/31	27	329
2003	04/30	05/06	05/11	05/16	05/26	06/04	06/06	07/11	20	29860
2004	04/15	05/05	05/08	05/10	05/16	05/24	05/31	07/06	15	22320

Figure B. 28: Historical outmigration run-timing at McNary of a composite of PIT-tagged wild steelhead trout from the Upper Columbia River and Snake River drainage.

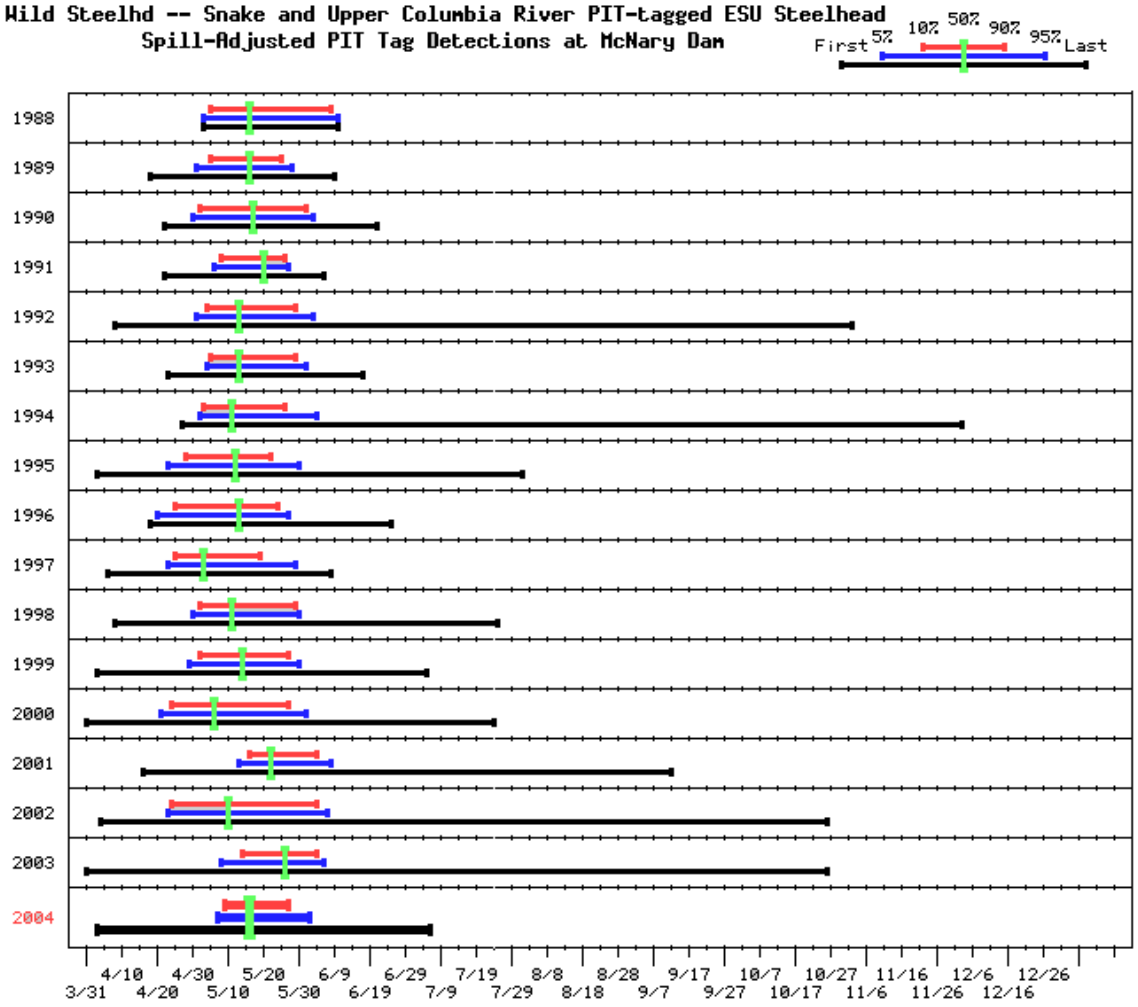


Table B. 28: Historical outmigration run-timing characteristics at McNary of a composite of PIT-tagged wild steelhead trout from the Upper Columbia River and Snake River drainage.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total MCN Passage
1988	05/03	05/03	05/03	05/05	05/16	06/08	06/10	06/10	35	18
1989	04/18	04/25	05/01	05/05	05/16	05/25	05/28	06/09	21	428
1990	04/22	04/26	04/30	05/02	05/17	06/01	06/03	06/21	31	399
1991	04/22	04/27	05/06	05/08	05/20	05/26	05/27	06/06	19	513
1992	04/08	04/24	05/01	05/04	05/13	05/29	06/03	11/02	26	877
1993	04/23	05/01	05/04	05/05	05/13	05/29	06/01	06/17	25	1055
1994	04/27	05/01	05/02	05/03	05/11	05/26	06/04	12/03	24	2313
1995	04/03	04/10	04/23	04/28	05/12	05/22	05/30	08/01	25	1668
1996	04/18	04/18	04/20	04/25	05/13	05/24	05/27	06/25	30	1378
1997	04/06	04/10	04/23	04/25	05/03	05/19	05/29	06/08	25	1349
1998	04/08	04/19	04/30	05/02	05/11	05/29	05/30	07/25	28	2880
1999	04/03	04/16	04/29	05/02	05/14	05/27	05/30	07/05	26	14570
2000	03/31	04/16	04/21	04/24	05/06	05/27	06/01	07/24	34	17333
2001	04/16	05/06	05/13	05/16	05/22	06/04	06/08	09/12	20	2833
2002	04/04	04/18	04/23	04/24	05/10	06/04	06/07	10/26	42	10755
2003	03/31	04/24	05/08	05/14	05/26	06/04	06/06	10/26	22	36229
2004	04/03	04/24	05/07	05/09	05/16	05/27	06/02	07/06	19	25316

Figure B. 29: Historical outmigration run-timing at McNary of PIT-tagged wild sockeye salmon from the Snake River drainage.

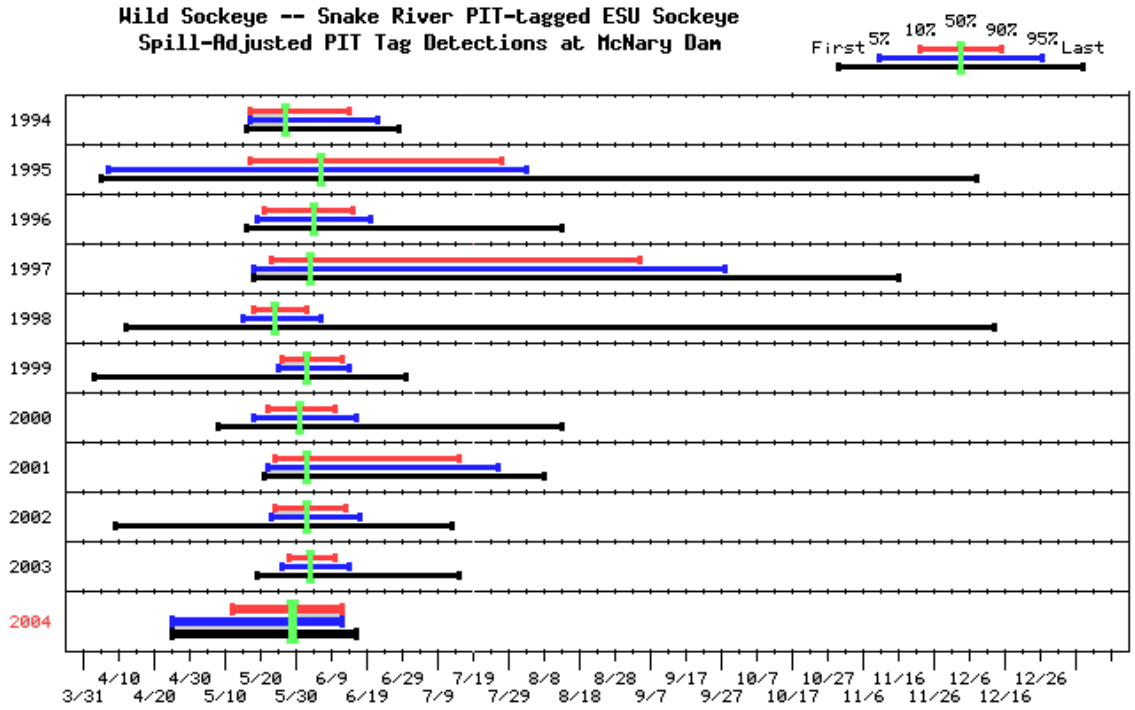


Table B. 29: Historical outmigration run-timing characteristics at McNary of PIT-tagged wild sockeye salmon from the Snake River drainage.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total MCN Passage
Year	First	1%	5%	10%	50%	90%	95%	Last		
1994	05/16	05/16	05/17	05/17	05/27	06/14	06/22	06/28	29	59
1995	04/05	04/05	04/07	05/17	06/06	07/27	08/03	12/08	72	37
1996	05/16	05/16	05/19	05/21	06/04	06/15	06/20	08/13	26	119
1997	05/18	05/18	05/18	05/23	06/03	09/04	09/28	11/16	105	38
1998	04/12	04/24	05/15	05/18	05/24	06/02	06/06	12/13	16	471
1999	04/03	05/04	05/25	05/26	06/02	06/12	06/14	06/30	18	347
2000	05/08	05/15	05/18	05/22	05/31	06/10	06/16	08/13	20	600
2001	05/21	05/21	05/22	05/24	06/02	07/15	07/26	08/08	53	38
2002	04/09	05/18	05/23	05/24	06/02	06/13	06/17	07/13	21	418
2003	05/19	05/22	05/26	05/28	06/03	06/10	06/14	07/15	14	615
2004	04/25	04/25	04/25	05/12	05/29	06/12	06/12	06/16	32	45

Figure B. 30: Historical outmigration run-timing at Lower Granite of a composite of PIT-tagged hatchery sockeye from Redfish Lake.

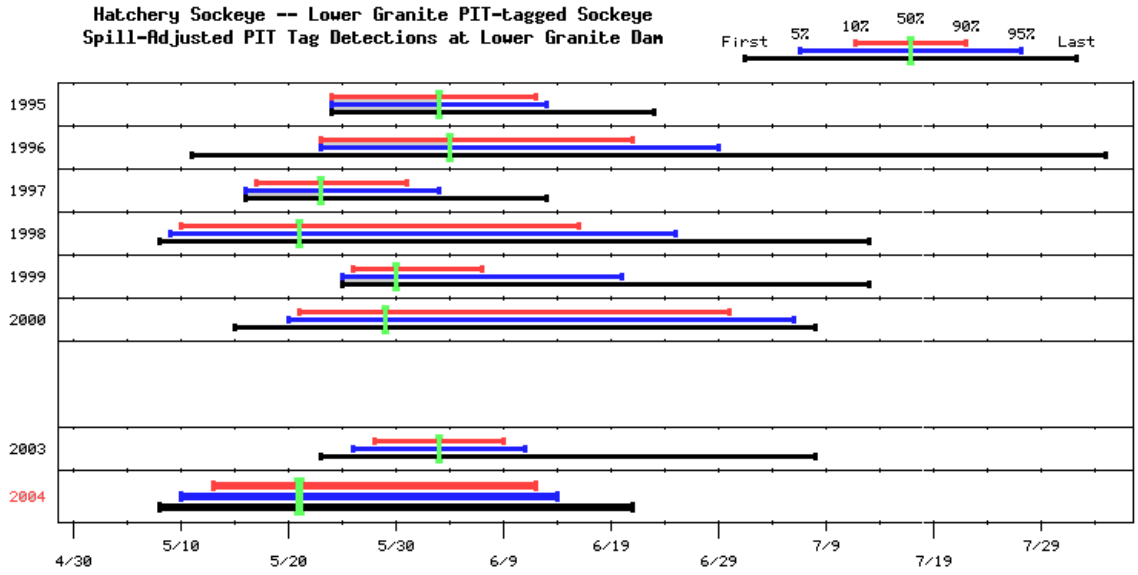


Table B. 30: Historical outmigration run-timing characteristics at Lower Granite of a composite of PIT-tagged hatchery sockeye from Redfish Lake.

	Detection Date												
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	# Parr Released	LWG PIT Counts	Adjusted PIT Counts	% Oberserved
1995	05/24	05/24	05/24	05/24	06/03	06/12	06/13	06/23	20	2728	20	26.6	1.0
1996	05/11	05/17	05/23	05/23	06/04	06/18	06/25	08/04	27	4246	160	377.8	8.9
1997	05/16	05/16	05/16	05/17	05/22	05/31	06/03	06/13	15	1930	53	131.2	6.8
1998	05/08	05/08	05/09	05/10	05/24	06/11	06/19	07/13	33	4692	71	145.6	3.1
1999	05/25	05/25	05/25	05/26	05/30	06/06	06/11	07/13	12	4179	58	143.9	3.4
2000	05/15	05/15	05/20	05/21	05/29	06/19	06/30	07/08	30	1557	42	80.5	5.2
2003	05/23	05/23	05/26	05/28	06/01	06/08	06/09	07/08	12	2022	51	123.1	6.1
2004	05/08	05/08	05/10	05/13	05/21	06/12	06/14	06/21	31	1519	96	106.9	0.1

Figure B. 31: Historical outmigration run-timing at Lower Granite of PIT-tagged wild subyearling chinook salmon from the Snake River drainage.

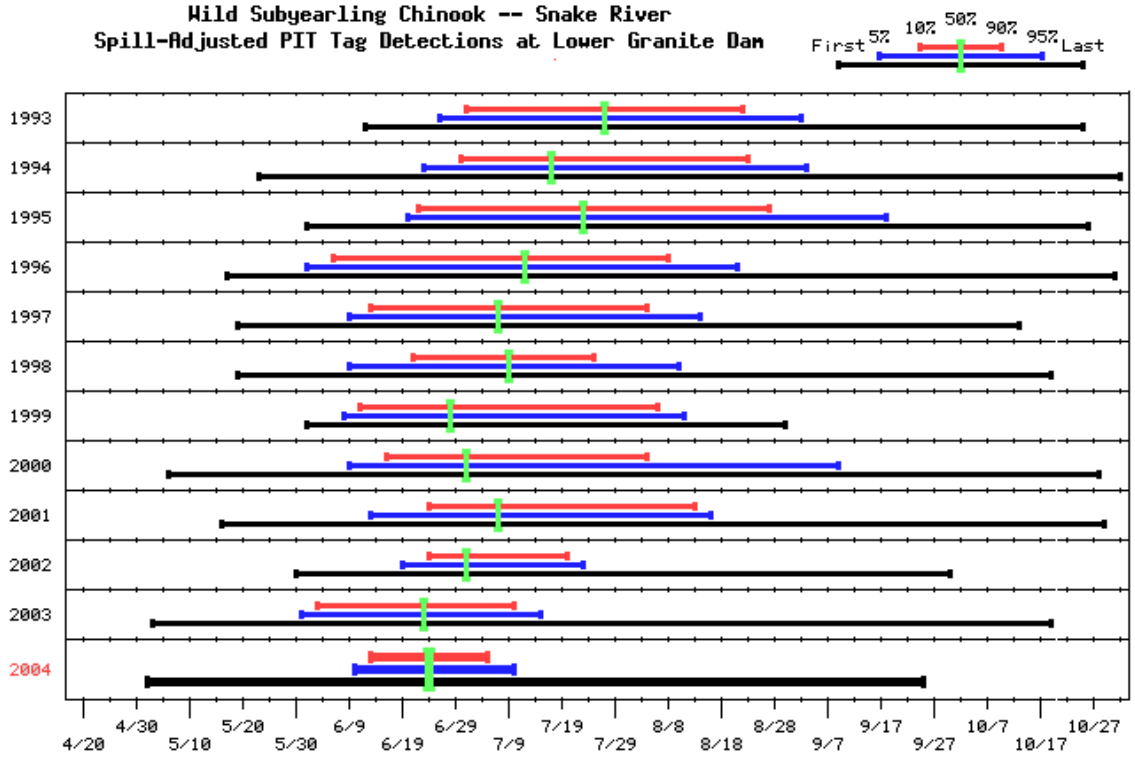


Table B. 31: Historical outmigration run-timing characteristics at Lower Granite of PIT-tagged wild subyearling chinook salmon from the Snake River drainage.

	Detection Date												
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	# Parr Released	LWG PIT Counts	Adjusted PIT Counts	% Oberserved
1993	06/12	06/20	06/26	07/01	07/27	08/22	09/02	10/25	(3)	(4)	(5)	(6)	(7)
1994	05/23	05/23	06/23	06/30	07/17	08/23	09/03	11/01	53	1770	172	172.1	9.7
1995	06/01	06/04	06/20	06/22	07/23	08/27	09/18	10/26	55	3040	193	199.1	6.6
1996	05/17	05/17	06/01	06/06	07/12	08/08	08/21	10/31	67	1828	440	454.0	24.8
1997	05/19	05/19	06/09	06/13	07/07	08/04	08/14	10/13	64	464	146	186.1	40.1
1998	05/19	05/26	06/09	06/21	07/09	07/25	08/10	10/19	53	641	124	164.3	25.6
1999	06/01	06/03	06/08	06/11	06/28	08/06	08/11	08/30	35	2060	549	676.1	32.8
2000	05/06	05/18	06/09	06/16	07/01	08/04	09/09	10/28	57	1761	559	802.5	45.6
2001	05/16	06/04	06/13	06/24	07/07	08/13	08/16	10/29	50	1209	327	376.0	31.1
2002	05/30	06/02	06/19	06/24	07/01	07/20	07/23	09/30	51	1392	195	196.8	14.1
2003	05/03	05/30	05/31	06/03	06/23	07/10	07/15	10/19	27	2405	493	790.5	32.9
2004	05/02	05/31	06/10	06/13	06/24	07/05	07/10	09/25	38	4740	1130	1459.0	30.8

Figure B. 32: Historical outmigration run-timing at McNary of PIT-tagged wild subyearling chinook salmon from the Snake River drainage.

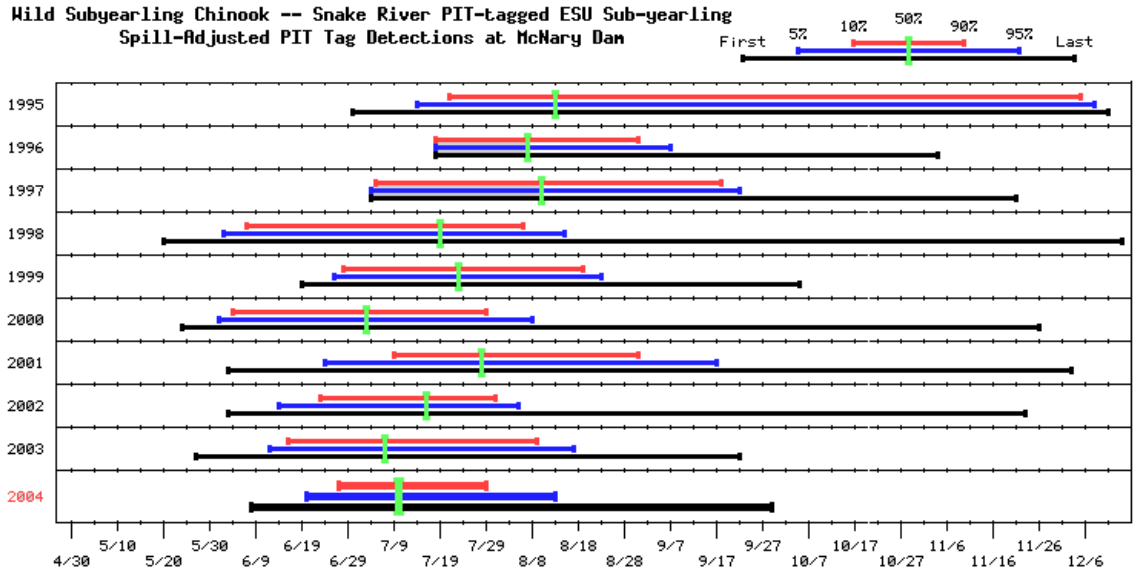


Table B. 32: Historical outmigration run-timing characteristics at McNary of PIT-tagged wild subyearling chinook salmon from the Snake River drainage.

	Detection Date								Middle 80% (days)	Total MCN Passage
Detection Year	First	1%	5%	10%	50%	90%	95%	Last		
1995	06/30	07/02	07/14	07/21	08/13	12/05	12/08	12/11	138	183
1996	07/18	07/18	07/18	07/18	08/07	08/31	09/07	11/04	45	28
1997	07/04	07/04	07/04	07/05	08/10	09/18	09/22	11/21	76	24
1998	05/20	05/29	06/02	06/07	07/19	08/06	08/15	12/14	61	439
1999	06/19	06/19	06/26	06/28	07/23	08/19	08/23	10/05	53	197
2000	05/24	05/27	06/01	06/04	07/03	07/29	08/08	11/26	56	274
2001	06/03	06/03	06/24	07/09	07/28	08/31	09/17	12/03	54	55
2002	06/03	06/05	06/14	06/23	07/16	07/31	08/05	11/23	39	512
2003	05/27	06/09	06/12	06/16	07/07	08/09	08/17	09/22	55	688
2004	06/08	06/12	06/20	06/27	07/10	07/29	08/13	09/29	33	744

Figure B. 33: Historical outmigration run-timing at McNary of PIT-tagged wild subyearling chinook salmon from the Upper Columbia River.

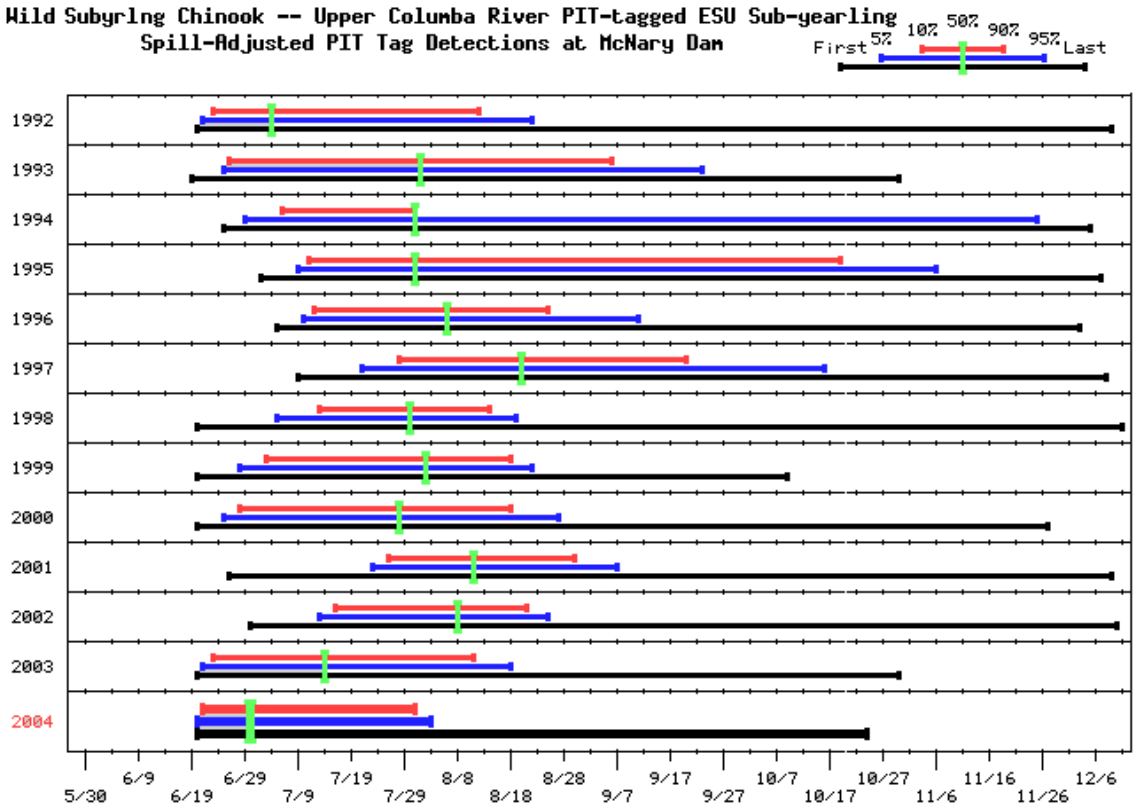


Table B. 33: Historical outmigration run-timing characteristics at McNary of PIT-tagged wild subyearling chinook salmon from the Upper Columbia River.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total MCN Passage
1992	06/20	06/20	06/21	06/23	07/04	08/12	08/22	12/09	51	678
1993	06/19	06/19	06/25	06/26	08/01	09/06	09/23	10/30	73	585
1994	06/25	06/26	06/29	07/06	07/31	11/19	11/25	12/05	137	559
1995	07/02	07/03	07/09	07/11	07/31	10/19	11/06	12/07	101	1029
1996	07/05	07/06	07/10	07/12	08/06	08/25	09/11	12/03	45	1375
1997	07/09	07/13	07/21	07/28	08/20	09/20	10/16	12/08	55	2342
1998	06/20	06/22	07/05	07/13	07/30	08/14	08/19	12/11	33	2524
1999	06/20	06/21	06/28	07/03	08/02	08/18	08/22	10/09	47	2544
2000	06/20	06/21	06/25	06/28	07/28	08/18	08/27	11/27	52	3279
2001	06/26	07/01	07/23	07/26	08/11	08/30	09/07	12/09	36	1210
2002	06/30	07/07	07/13	07/16	08/08	08/21	08/25	12/10	37	1530
2003	06/20	06/20	06/21	06/23	07/14	08/11	08/18	10/30	50	1357
2004	06/20	06/20	06/20	06/21	06/30	07/31	08/03	10/24	41	773

Figure B. 34: Historical outmigration run-timing of passage-indexed combined wild and hatchery run-at-large yearling chinook at Rock Island Dam.

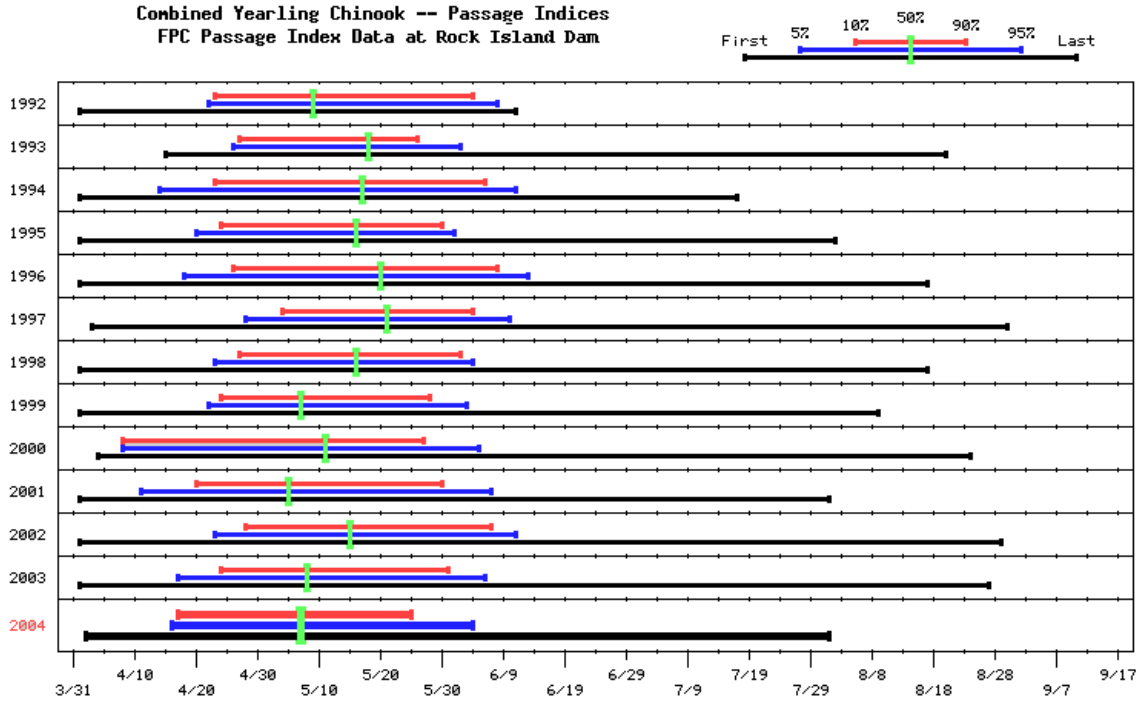


Table B. 34: Historical outmigration run-timing characteristics of passage-indexed combined wild and hatchery run-at-large yearling chinook at Rock Island Dam.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total RIS Passage
1992	04/01	04/17	04/22	04/23	05/09	06/04	06/08	06/11	43	16100
1993	04/15	04/21	04/26	04/27	05/18	05/26	06/02	08/20	30	13514
1994	04/01	04/04	04/14	04/23	05/17	06/06	06/11	07/17	45	12324
1995	04/01	04/09	04/20	04/24	05/16	05/30	06/01	08/02	37	30753
1996	04/01	04/07	04/18	04/26	05/20	06/08	06/13	08/17	44	42478
1997	04/03	04/17	04/28	05/04	05/21	06/04	06/10	08/30	32	53754
1998	04/01	04/03	04/23	04/27	05/16	06/02	06/04	08/17	37	24859
1999	04/01	04/11	04/22	04/24	05/07	05/28	06/03	08/09	35	40320
2000	04/04	04/08	04/08	04/08	05/11	05/27	06/05	08/24	50	32334
2001	04/01	04/06	04/11	04/20	05/05	05/30	06/07	08/01	41	6635
2002	04/01	04/12	04/23	04/28	05/15	06/07	06/11	08/29	41	28982
2003	04/01	04/16	04/17	04/24	05/08	05/31	06/06	08/27	38	15355
2004	04/02	04/07	04/16	04/17	05/07	05/25	06/04	08/01	39	12574

Figure B. 35: Historical outmigration run-timing of passage-indexed combined wild and hatchery run-at-large yearling chinook at McNary Dam.

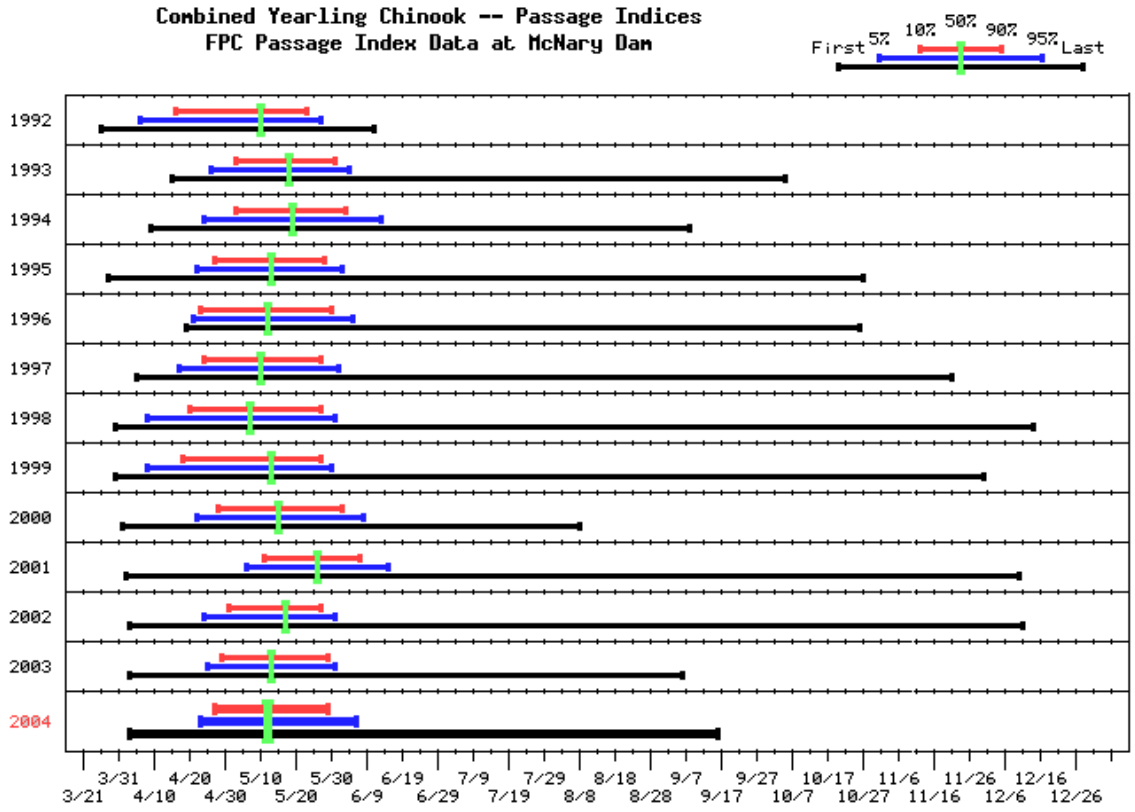


Table B. 35: Historical outmigration run-timing characteristics of passage-indexed combined wild and hatchery run-at-large yearling chinook at McNary Dam.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total MCN Passage
1992	03/26	04/04	04/06	04/16	05/10	05/23	05/27	06/11	38	2514319
1993	04/15	04/18	04/26	05/03	05/18	05/31	06/04	10/05	29	1729010
1994	04/09	04/13	04/24	05/03	05/19	06/03	06/13	09/08	32	2572338
1995	03/28	04/08	04/22	04/27	05/13	05/28	06/02	10/27	32	2879069
1996	04/19	04/19	04/21	04/23	05/12	05/30	06/05	10/26	38	1240878
1997	04/05	04/06	04/17	04/24	05/10	05/27	06/01	11/21	34	1184530
1998	03/30	04/05	04/08	04/20	05/07	05/27	05/31	12/14	38	1727071
1999	03/30	04/05	04/08	04/18	05/13	05/27	05/30	11/30	40	3692944
2000	04/01	04/10	04/22	04/28	05/15	06/02	06/08	08/08	36	1986380
2001	04/02	04/26	05/06	05/11	05/26	06/07	06/15	12/10	28	2299563
2002	04/03	04/17	04/24	05/01	05/17	05/27	05/31	12/11	27	3519382
2003	04/03	04/15	04/25	04/29	05/13	05/29	05/31	09/06	31	1624087
2004	04/03	04/17	04/23	04/27	05/12	05/29	06/06	09/16	33	1085821

Figure B. 36: Historical outmigration run-timing of passage-indexed combined wild and hatchery run-at-large yearling chinook at John Day Dam.

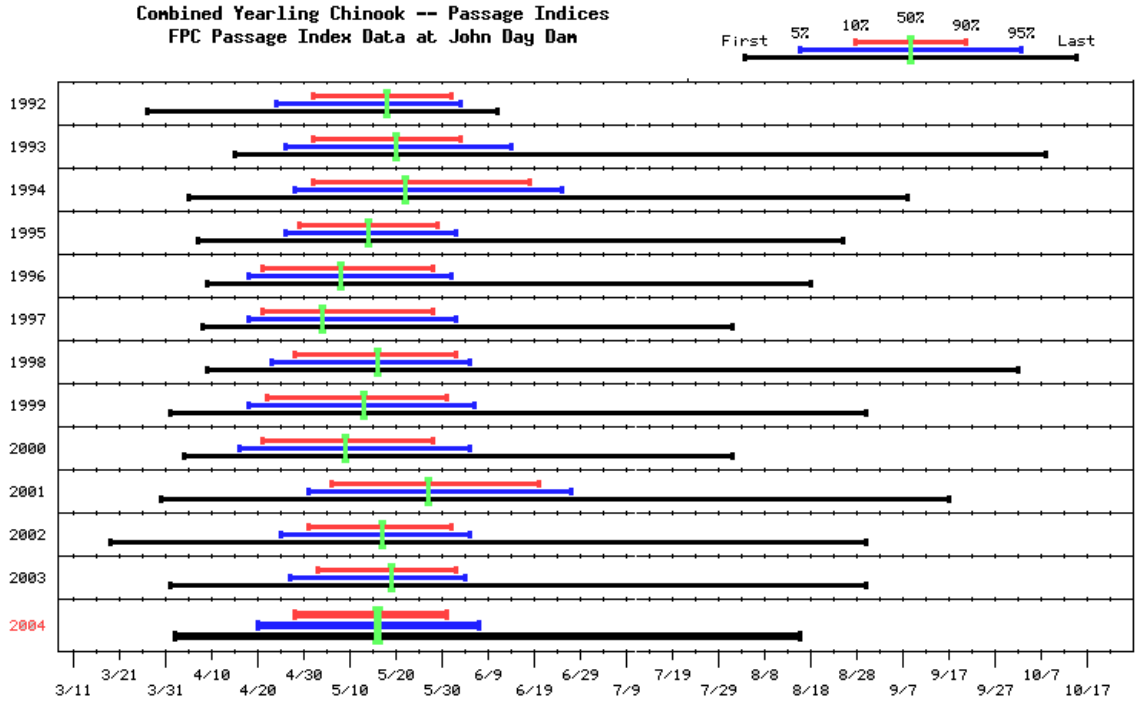


Table B. 36: Historical outmigration run-timing characteristics of passage-indexed combined wild and hatchery run-at-large yearling chinook at John Day Dam.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total JDA Passage
1992	03/27	04/14	04/24	05/02	05/18	06/01	06/03	06/11	31	478132
1993	04/15	04/19	04/26	05/02	05/20	06/03	06/14	10/08	33	762565
1994	04/05	04/18	04/28	05/02	05/22	06/18	06/25	09/08	48	446549
1995	04/07	04/16	04/26	04/29	05/14	05/29	06/02	08/25	31	1328883
1996	04/09	04/14	04/18	04/21	05/08	05/28	06/01	08/18	38	738453
1997	04/08	04/12	04/18	04/21	05/04	05/28	06/02	08/01	38	154493
1998	04/09	04/13	04/23	04/28	05/16	06/02	06/05	10/02	36	1147281
1999	04/01	04/10	04/18	04/22	05/13	05/31	06/06	08/30	40	2193902
2000	04/04	04/10	04/16	04/21	05/09	05/28	06/05	08/01	38	822349
2001	03/30	04/21	05/01	05/06	05/27	06/20	06/27	09/17	46	1006078
2002	03/19	04/18	04/25	05/01	05/17	06/01	06/05	08/30	32	2112370
2003	04/01	04/14	04/27	05/03	05/19	06/02	06/04	08/30	31	2074457
2004	04/02	04/09	04/20	04/28	05/16	05/30	06/06	08/17	33	1005416

Figure B. 37: Historical outmigration run-timing of passage-indexed combined wild and hatchery run-at-large yearling chinook at Bonneville Dam.

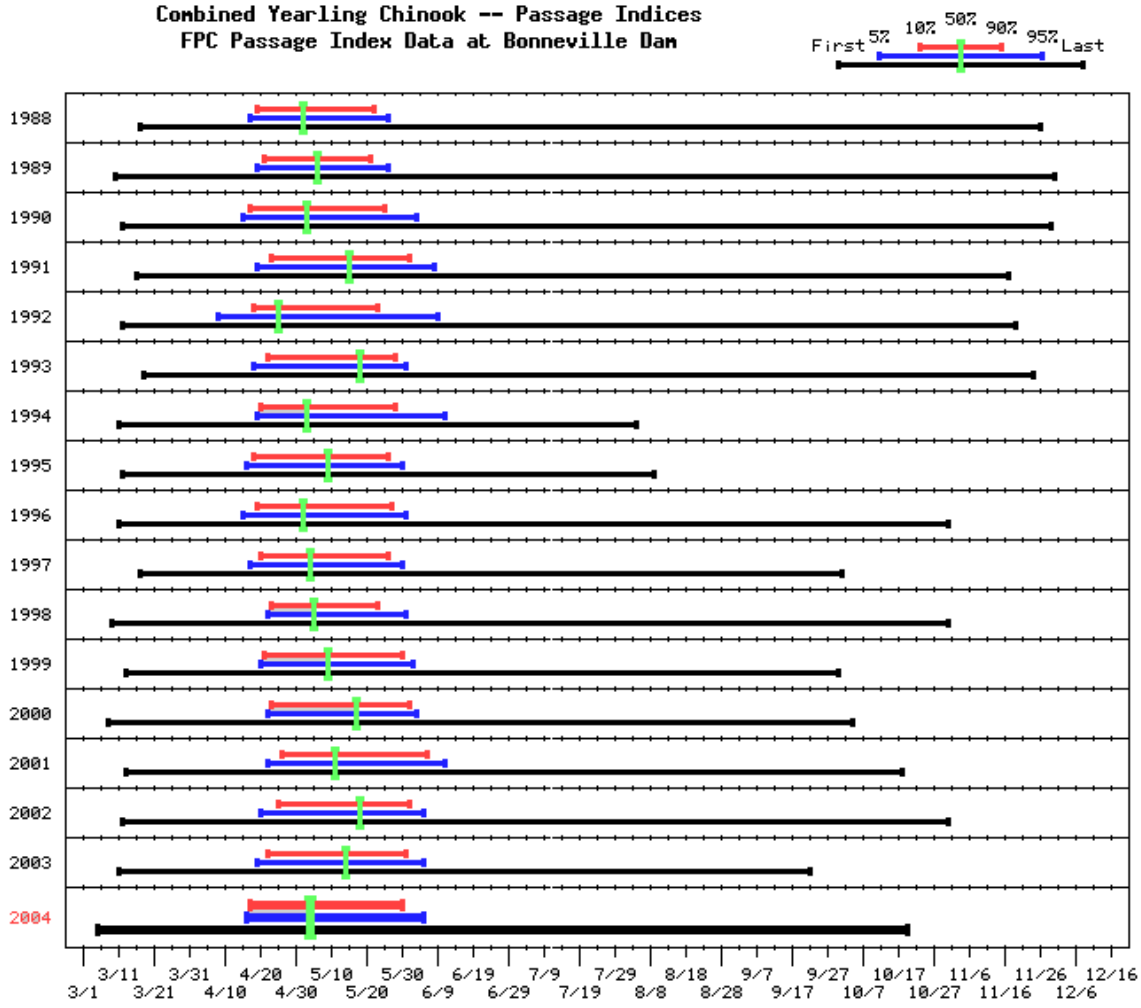


Table B. 37: Historical outmigration run-timing characteristics of passage-indexed combined wild and hatchery run-at-large yearling chinook at Bonneville Dam.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total BON Passage
1988	03/17	04/14	04/17	04/19	05/02	05/22	05/26	11/26	34	365812
1989	03/10	04/11	04/19	04/21	05/06	05/21	05/26	11/30	31	435451
1990	03/12	04/10	04/15	04/17	05/03	05/25	06/03	11/29	39	337787
1991	03/16	04/17	04/19	04/23	05/15	06/01	06/08	11/17	40	609417
1992	03/12	03/16	04/08	04/18	04/25	05/23	06/09	11/19	36	723652
1993	03/18	03/26	04/18	04/22	05/18	05/28	05/31	11/24	37	2168048
1994	03/11	04/15	04/19	04/20	05/03	05/28	06/11	08/04	39	779720
1995	03/12	04/08	04/16	04/18	05/09	05/26	05/30	08/09	39	1776322
1996	03/11	03/15	04/15	04/19	05/02	05/27	05/31	10/31	39	470112
1997	03/17	03/20	04/17	04/20	05/04	05/26	05/30	10/01	37	286142
1998	03/09	03/26	04/22	04/23	05/05	05/23	05/31	10/31	31	346280
1999	03/13	04/01	04/20	04/21	05/09	05/30	06/02	09/30	40	638607
2000	03/08	04/12	04/22	04/23	05/17	06/01	06/03	10/04	40	2535055
2001	03/13	04/14	04/22	04/26	05/11	06/06	06/11	10/18	42	1688673
2002	03/12	04/16	04/20	04/25	05/18	06/01	06/05	10/31	38	3349185
2003	03/11	04/12	04/19	04/22	05/14	05/31	06/05	09/22	40	4043776
2004	03/05	04/09	04/16	04/17	05/04	05/30	06/05	10/20	44	1449398

Figure B. 38: Historical outmigration run-timing of passage-indexed combined wild and hatchery run-at-large steelhead trout at Rock Island Dam.

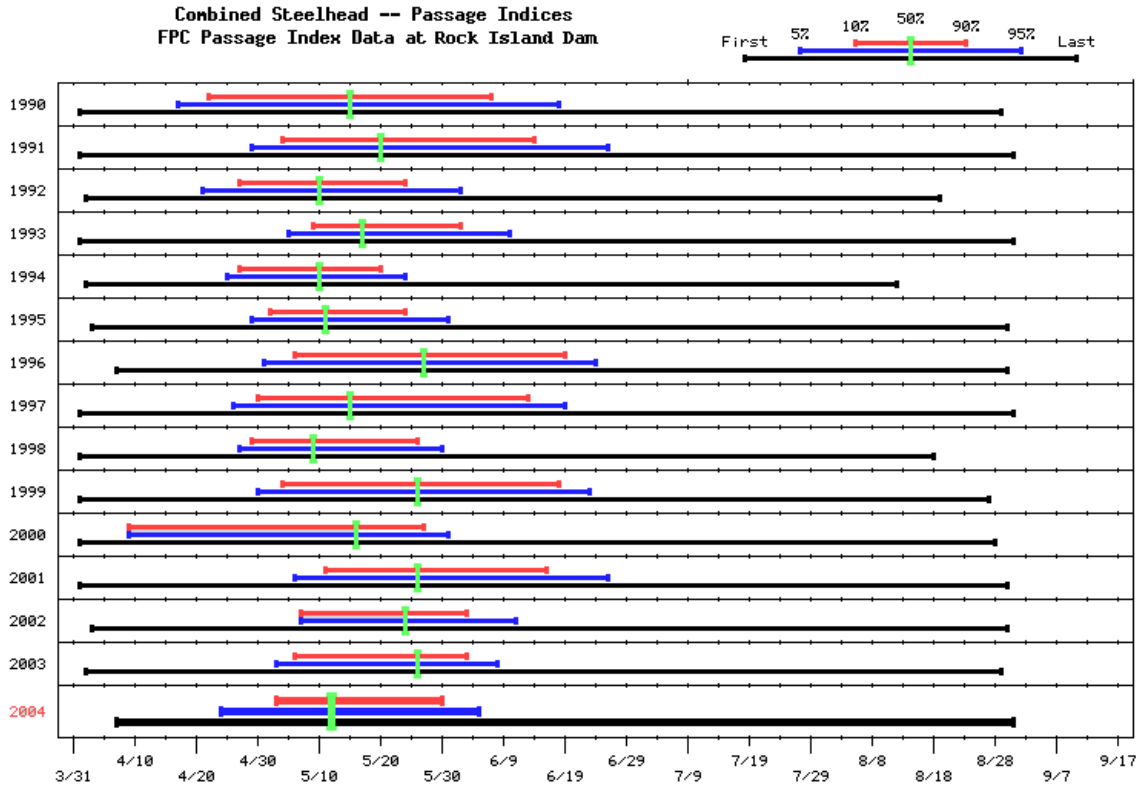


Table B. 38: Historical outmigration run-timing characteristics of passage-indexed combined wild and hatchery run-at-large steelhead trout at Rock Island Dam.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total RIS Passage
1990	04/01	04/06	04/17	04/22	05/15	06/07	06/18	08/29	47	3739
1991	04/01	04/10	04/29	05/04	05/20	06/14	06/26	08/31	42	4953
1992	04/02	04/07	04/21	04/27	05/10	05/24	06/02	08/19	28	4906
1993	04/01	04/21	05/05	05/09	05/17	06/02	06/10	08/31	25	4032
1994	04/02	04/21	04/25	04/27	05/10	05/20	05/24	08/12	24	15323
1995	04/03	04/22	04/29	05/02	05/11	05/24	05/31	08/30	23	18084
1996	04/07	04/21	05/01	05/06	05/27	06/19	06/24	08/30	45	39650
1997	04/01	04/19	04/26	04/30	05/15	06/13	06/19	08/31	45	33979
1998	04/01	04/22	04/27	04/29	05/09	05/26	05/30	08/18	28	21390
1999	04/01	04/23	04/30	05/04	05/26	06/18	06/23	08/27	46	48192
2000	04/01	04/08	04/09	04/09	05/16	05/27	05/31	08/28	49	26297
2001	04/01	04/26	05/06	05/11	05/26	06/16	06/26	08/30	37	17914
2002	04/03	04/20	05/07	05/07	05/24	06/03	06/11	08/30	28	28714
2003	04/02	04/26	05/03	05/06	05/26	06/03	06/08	08/29	29	15507
2004	04/07	04/16	04/24	05/03	05/12	05/30	06/05	08/31	28	10735

Figure B. 39: Historical outmigration run-timing of passage-indexed combined wild and hatchery run-at-large steelhead trout at McNary Dam.

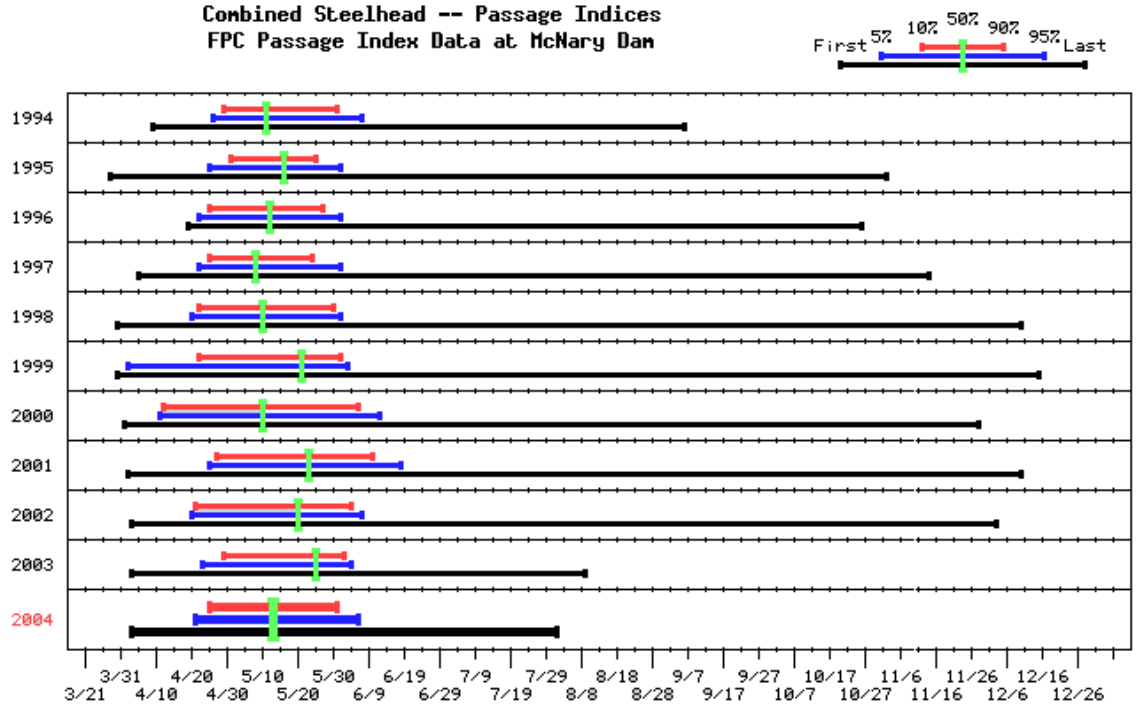


Table B. 39: Historical outmigration run-timing characteristics of passage-indexed combined wild and hatchery run-at-large steelhead trout at McNary Dam.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total MCN Passage
1994	04/09	04/19	04/26	04/29	05/11	05/31	06/07	09/06	33	106520
1995	03/28	04/05	04/25	05/01	05/16	05/25	06/01	11/02	25	734878
1996	04/19	04/20	04/22	04/25	05/12	05/27	06/01	10/26	33	792462
1997	04/05	04/19	04/22	04/25	05/08	05/24	06/01	11/14	30	1234024
1998	03/30	04/16	04/20	04/22	05/10	05/30	06/01	12/10	39	571119
1999	03/30	03/30	04/02	04/22	05/21	06/01	06/03	12/15	41	1004348
2000	04/01	04/09	04/11	04/12	05/10	06/06	06/12	11/28	56	617482
2001	04/02	04/18	04/25	04/27	05/23	06/10	06/18	12/10	45	563299
2002	04/03	04/16	04/20	04/21	05/20	06/04	06/07	12/03	45	794580
2003	04/03	04/09	04/23	04/29	05/25	06/02	06/04	08/09	35	245583
2004	04/03	04/15	04/21	04/25	05/13	05/31	06/06	08/01	37	125285

Figure B. 40: Historical outmigration run-timing of passage-indexed combined wild and hatchery run-at-large steelhead trout at John Day Dam.

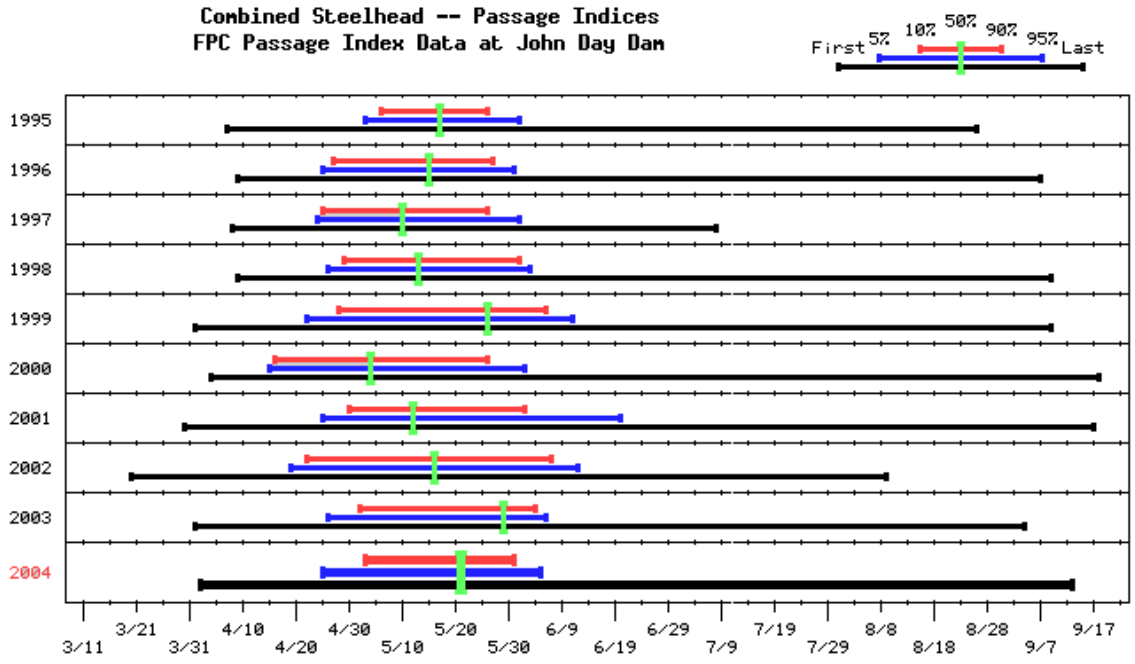


Table B. 40: Historical outmigration run-timing characteristics of passage-indexed combined wild and hatchery run-at-large steelhead trout at John Day Dam.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total JDA Passage
1995	04/07	04/17	05/03	05/06	05/17	05/26	06/01	08/26	21	1089894
1996	04/09	04/18	04/25	04/27	05/15	05/27	05/31	09/07	31	930931
1997	04/08	04/21	04/24	04/25	05/10	05/26	06/01	07/08	32	773788
1998	04/09	04/22	04/26	04/29	05/13	06/01	06/03	09/09	34	1089156
1999	04/01	04/02	04/22	04/28	05/26	06/06	06/11	09/09	40	1238944
2000	04/04	04/12	04/15	04/16	05/04	05/26	06/02	09/18	41	517289
2001	03/30	04/16	04/25	04/30	05/12	06/02	06/20	09/17	34	191132
2002	03/20	04/14	04/19	04/22	05/16	06/07	06/12	08/09	47	547546
2003	04/01	04/11	04/26	05/02	05/29	06/04	06/06	09/04	34	553495
2004	04/02	04/12	04/25	05/03	05/21	05/31	06/05	09/13	29	257272

Figure B. 41: Historical outmigration run-timing of passage-indexed combined wild and hatchery run-at-large steelhead trout at Bonneville Dam.

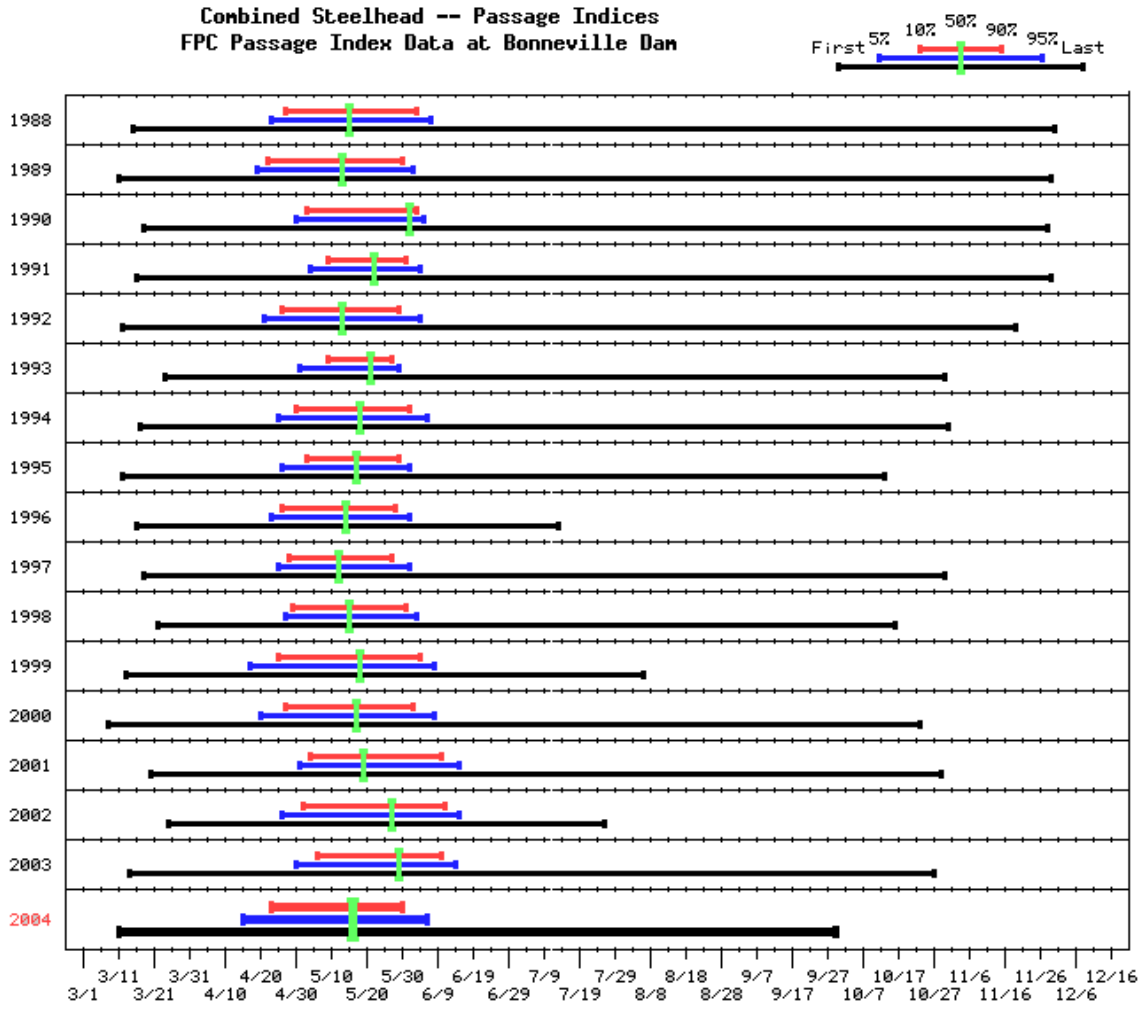


Table B. 41: Historical outmigration run-timing characteristics of passage-indexed combined wild and hatchery run-at-large steelhead trout at Bonneville Dam.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total BON Passage
1988	03/15	04/14	04/23	04/27	05/15	06/03	06/07	11/30	38	103703
1989	03/11	04/13	04/19	04/22	05/13	05/30	06/02	11/29	39	206225
1990	03/18	04/20	04/30	05/03	06/01	06/03	06/05	11/28	32	202891
1991	03/16	04/21	05/04	05/09	05/22	05/31	06/04	11/29	23	230199
1992	03/12	04/11	04/21	04/26	05/13	05/29	06/04	11/19	34	108585
1993	03/24	04/15	05/01	05/09	05/21	05/27	05/29	10/30	19	790024
1994	03/17	04/15	04/25	04/30	05/18	06/01	06/06	10/31	33	199211
1995	03/12	04/12	04/26	05/03	05/17	05/29	06/01	10/13	27	483444
1996	03/16	04/16	04/23	04/26	05/14	05/28	06/01	07/13	33	436835
1997	03/18	04/19	04/25	04/28	05/12	05/27	06/01	10/30	30	780841
1998	03/22	04/19	04/27	04/29	05/15	05/31	06/03	10/16	33	397210
1999	03/13	04/03	04/17	04/25	05/18	06/04	06/08	08/06	41	351309
2000	03/08	04/15	04/20	04/27	05/17	06/02	06/08	10/23	37	657064
2001	03/20	04/20	05/01	05/04	05/19	06/10	06/15	10/29	38	489392
2002	03/25	04/18	04/26	05/02	05/27	06/11	06/15	07/26	41	1462261
2003	03/14	04/19	04/30	05/06	05/29	06/10	06/14	10/27	36	1635181
2004	03/11	04/05	04/15	04/23	05/16	05/30	06/06	09/30	38	153204

Figure B. 42: Historical outmigration run-timing of passage-indexed combined wild and hatchery run-at-large coho salmon at Rock Island Dam.

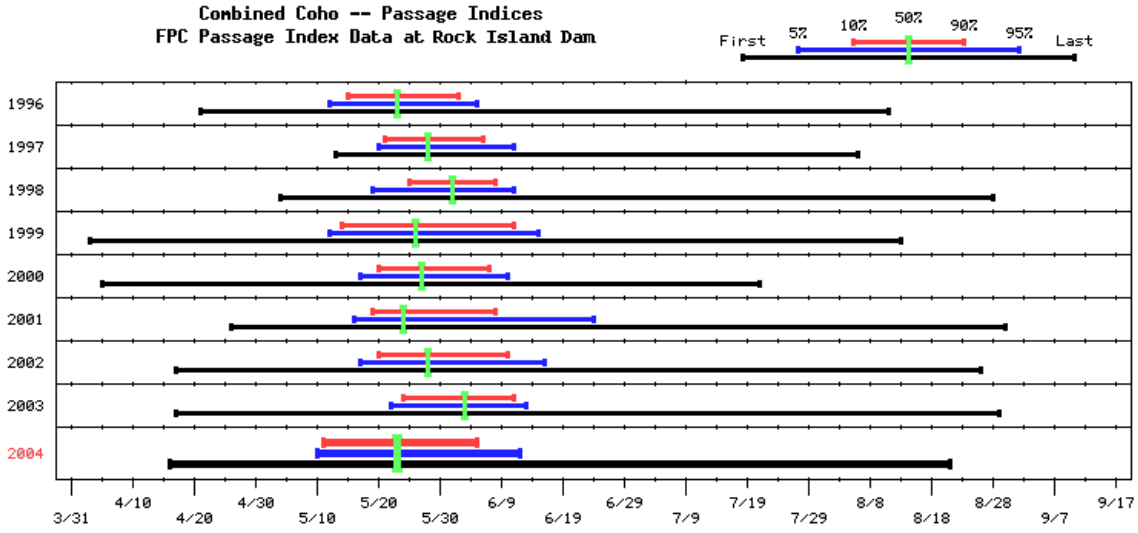


Table B. 42: Historical outmigration run-timing characteristics of passage-indexed combined wild and hatchery run-at-large coho salmon at Rock Island Dam.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total RIS Passage
1996	04/21	05/03	05/12	05/15	05/23	06/02	06/05	08/11	19	26521
1997	05/13	05/18	05/20	05/21	05/28	06/06	06/11	08/06	17	4301
1998	05/04	05/07	05/19	05/25	06/01	06/08	06/11	08/28	15	41837
1999	04/03	05/03	05/12	05/14	05/26	06/11	06/15	08/13	29	46173
2000	04/05	05/08	05/17	05/20	05/27	06/07	06/10	07/21	19	49552
2001	04/26	05/12	05/16	05/19	05/24	06/08	06/24	08/30	21	45437
2002	04/17	05/12	05/17	05/20	05/28	06/10	06/16	08/26	22	86227
2003	04/17	05/14	05/22	05/24	06/03	06/11	06/13	08/29	19	41690
2004	04/16	05/07	05/10	05/11	05/23	06/05	06/12	08/21	26	28668

Figure B. 43: Historical outmigration run-timing of passage-indexed combined wild and hatchery run-at-large coho salmon at McNary Dam.

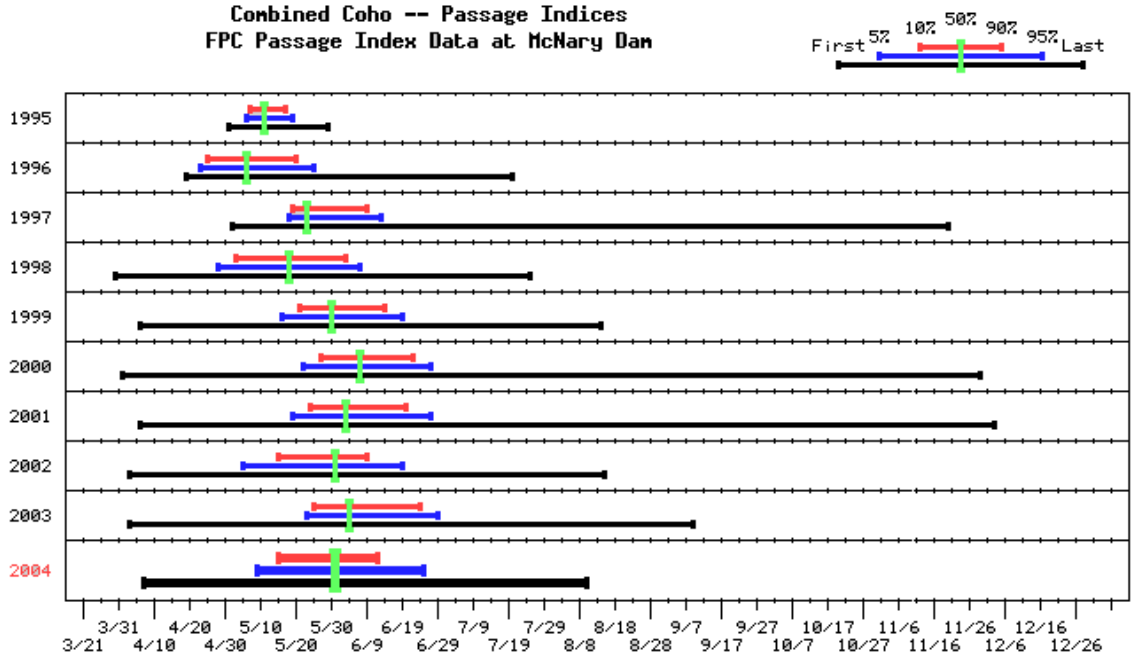


Table B. 43: Historical outmigration run-timing characteristics of passage-indexed combined wild and hatchery run-at-large coho salmon at McNary Dam.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total MCN Passage
1995	05/01	05/03	05/06	05/07	05/11	05/17	05/19	05/29	11	236480
1996	04/19	04/20	04/23	04/25	05/06	05/20	05/25	07/20	26	647586
1997	05/02	05/15	05/18	05/19	05/23	06/09	06/13	11/20	22	339949
1998	03/30	04/21	04/28	05/03	05/18	06/03	06/07	07/25	32	241239
1999	04/06	05/05	05/16	05/21	05/30	06/14	06/19	08/14	25	281977
2000	04/01	05/01	05/22	05/27	06/07	06/22	06/27	11/29	27	260058
2001	04/06	05/03	05/19	05/24	06/03	06/20	06/27	12/03	28	147063
2002	04/03	04/19	05/05	05/15	05/31	06/09	06/19	08/15	26	201998
2003	04/03	05/07	05/23	05/25	06/04	06/24	06/29	09/09	31	113584
2004	04/07	04/29	05/09	05/15	05/31	06/12	06/25	08/10	29	90681

Figure B. 44: Historical outmigration run-timing of passage-indexed combined wild and hatchery run-at-large coho salmon at John Day Dam.

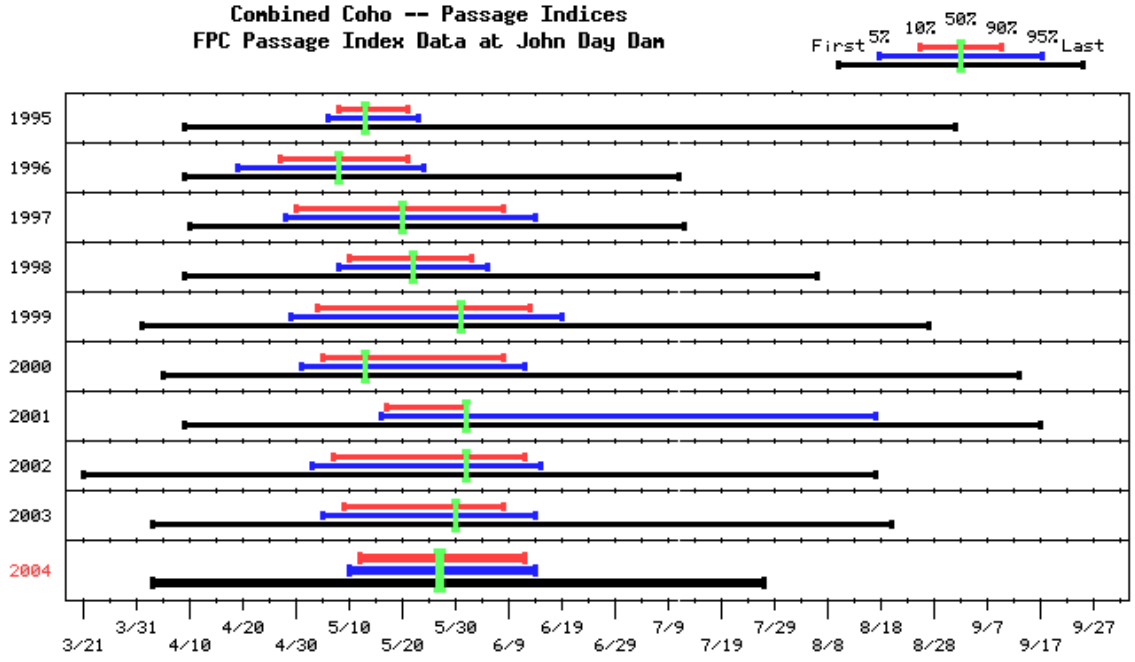


Table B. 44: Historical outmigration run-timing characteristics of passage-indexed combined wild and hatchery run-at-large coho salmon at John Day Dam.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total JDA Passage
1995	04/09	05/04	05/06	05/08	05/13	05/21	05/23	09/01	14	335903
1996	04/09	04/14	04/19	04/27	05/08	05/21	05/24	07/11	25	504884
1997	04/10	04/25	04/28	04/30	05/20	06/08	06/14	07/12	40	148139
1998	04/09	05/04	05/08	05/10	05/22	06/02	06/05	08/06	24	572290
1999	04/01	04/22	04/29	05/04	05/31	06/13	06/19	08/27	41	543321
2000	04/05	04/23	05/01	05/05	05/13	06/08	06/12	09/13	35	262656
2001	04/09	05/04	05/16	05/17	06/01	08/14	08/17	09/17	90	81644
2002	03/21	04/24	05/03	05/07	06/01	06/12	06/15	08/17	37	316507
2003	04/03	04/28	05/05	05/09	05/30	06/08	06/14	08/20	31	258239
2004	04/03	04/30	05/10	05/12	05/27	06/12	06/14	07/27	32	175311

Figure B. 45: Historical outmigration run-timing of passage-indexed combined wild and hatchery run-at-large coho salmon at Bonneville Dam.

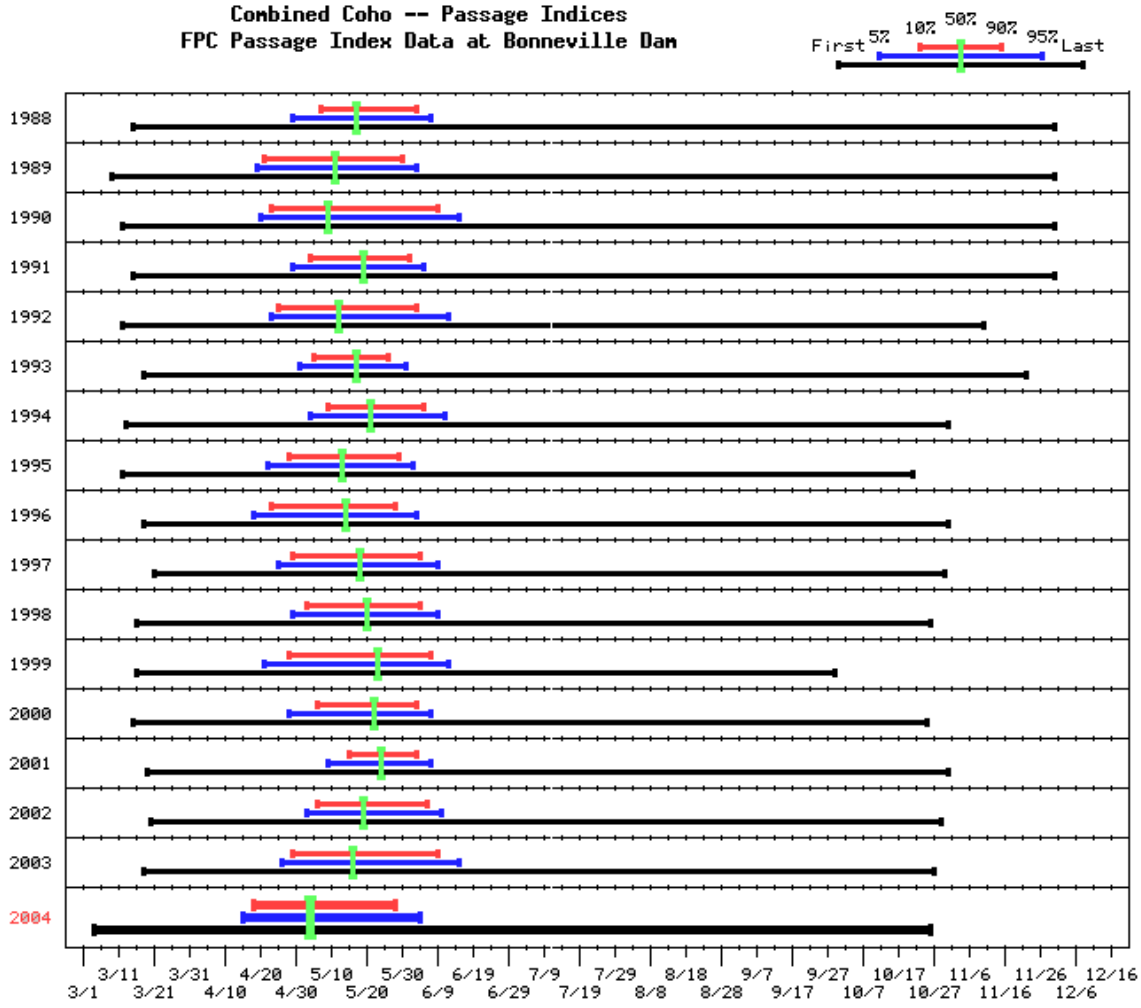


Table B. 45: Historical outmigration run-timing characteristics of passage-indexed combined wild and hatchery run-at-large coho salmon at Bonneville Dam.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total BON Passage
1988	03/15	04/21	04/29	05/07	05/17	06/03	06/07	11/30	28	599194
1989	03/09	04/14	04/19	04/21	05/11	05/30	06/03	11/30	40	491615
1990	03/12	04/14	04/20	04/23	05/09	06/09	06/15	11/30	48	677407
1991	03/15	04/18	04/29	05/04	05/19	06/01	06/05	11/30	29	575107
1992	03/12	04/12	04/23	04/25	05/12	06/03	06/12	11/10	40	388807
1993	03/18	04/20	05/01	05/05	05/17	05/26	05/31	11/22	22	1250712
1994	03/13	04/26	05/04	05/09	05/21	06/05	06/11	10/31	28	626437
1995	03/12	04/13	04/22	04/28	05/13	05/29	06/02	10/21	32	1104448
1996	03/18	04/12	04/18	04/23	05/14	05/28	06/03	10/31	36	863814
1997	03/21	04/16	04/25	04/29	05/18	06/04	06/09	10/30	37	706544
1998	03/16	04/22	04/29	05/03	05/20	06/04	06/09	10/26	33	513645
1999	03/16	04/10	04/21	04/28	05/23	06/07	06/12	09/29	41	375644
2000	03/15	04/17	04/28	05/06	05/22	06/03	06/07	10/25	29	1977556
2001	03/19	05/03	05/09	05/15	05/24	06/03	06/07	10/31	20	2164026
2002	03/20	04/18	05/03	05/06	05/19	06/06	06/10	10/29	32	2341191
2003	03/18	04/21	04/26	04/29	05/16	06/09	06/15	10/27	42	2116570
2004	03/04	04/12	04/15	04/18	05/04	05/27	06/03	10/27	40	918385

Figure B. 46: Historical outmigration run-timing of passage-indexed combined wild and hatchery run-at-large sockeye salmon at Rock Island Dam.

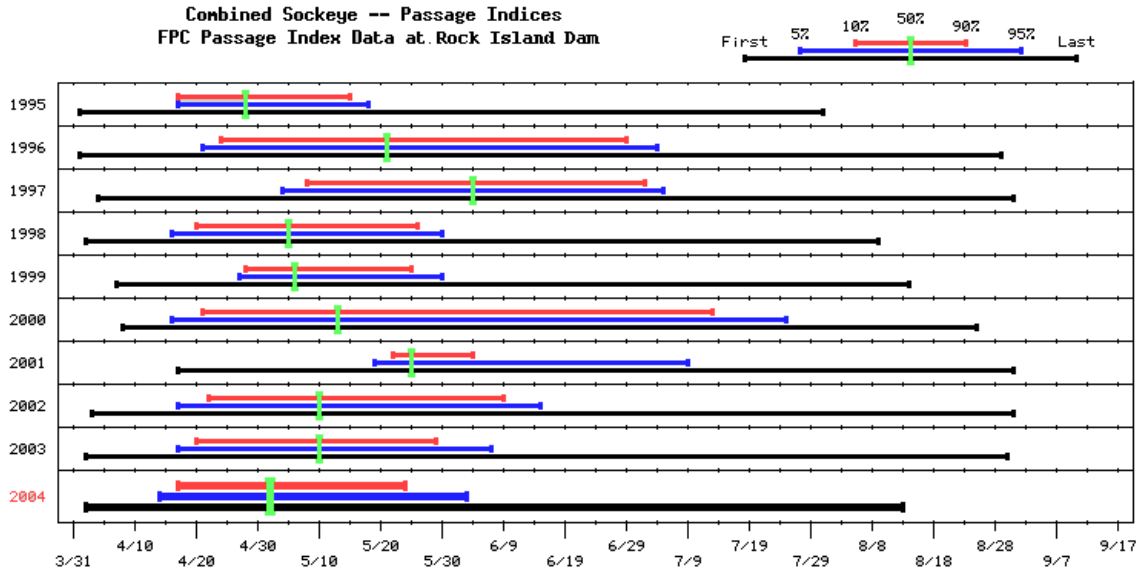


Table B. 46: Historical outmigration run-timing characteristics of passage-indexed combined wild and hatchery run-at-large sockeye salmon at Rock Island Dam.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total RIS Passage
1995	04/01	04/13	04/17	04/17	04/28	05/15	05/18	07/31	29	27056
1996	04/01	04/15	04/21	04/24	05/21	06/29	07/04	08/29	67	9995
1997	04/04	04/26	05/04	05/08	06/04	07/02	07/05	08/31	56	13426
1998	04/02	04/14	04/16	04/20	05/05	05/26	05/30	08/09	37	16635
1999	04/07	04/21	04/27	04/28	05/06	05/25	05/30	08/14	28	23371
2000	04/08	04/12	04/16	04/21	05/13	07/13	07/25	08/25	84	2430
2001	04/17	04/24	05/19	05/22	05/25	06/04	07/09	08/31	14	3032
2002	04/03	04/15	04/17	04/22	05/10	06/09	06/15	08/31	49	20629
2003	04/02	04/11	04/17	04/20	05/10	05/29	06/07	08/30	40	10312
2004	04/02	04/11	04/14	04/17	05/02	05/24	06/03	08/13	38	7114

Figure B. 47: Historical outmigration run-timing of passage-indexed combined wild and hatchery run-at-large sockeye salmon at McNary Dam.

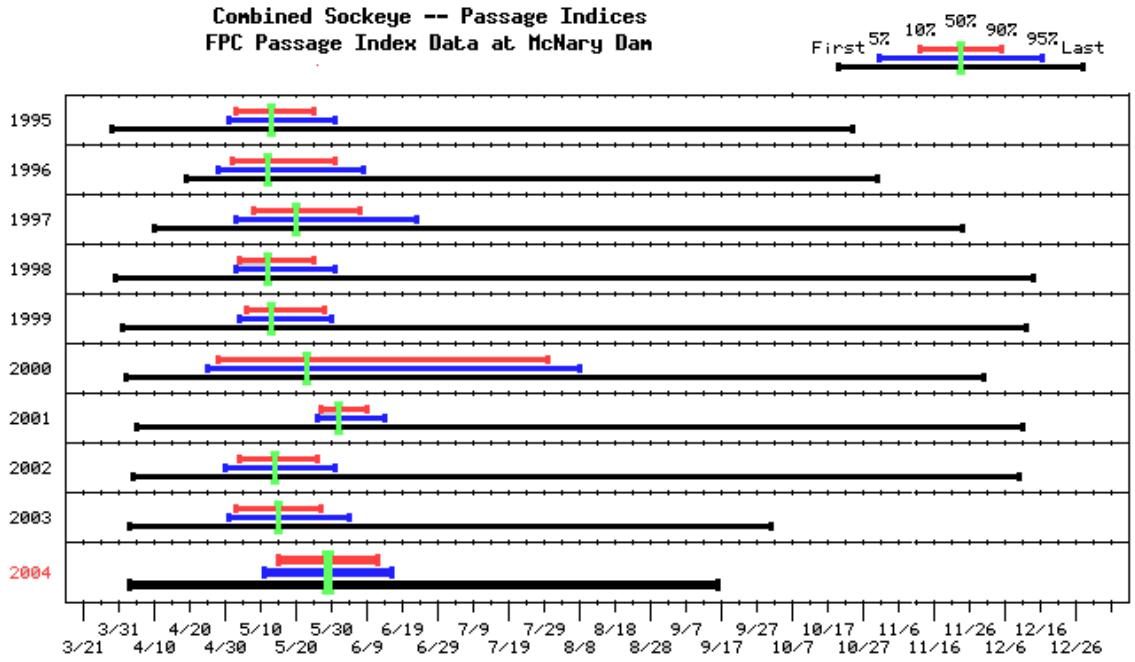


Table B. 47: Historical outmigration run-timing characteristics of passage-indexed combined wild and hatchery run-at-large sockeye salmon at McNary Dam.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total MCN Passage
1995	03/29	04/28	05/01	05/03	05/13	05/25	05/31	10/24	23	1003494
1996	04/19	04/24	04/28	05/02	05/12	05/31	06/08	10/31	30	155094
1997	04/10	04/29	05/03	05/08	05/20	06/07	06/23	11/24	31	221166
1998	03/30	04/29	05/03	05/04	05/12	05/25	05/31	12/14	22	966549
1999	04/01	04/29	05/04	05/06	05/13	05/28	05/30	12/12	23	1446326
2000	04/02	04/21	04/25	04/28	05/23	07/30	08/08	11/30	94	139909
2001	04/05	05/12	05/26	05/27	06/01	06/09	06/14	12/11	14	285741
2002	04/04	04/23	04/30	05/04	05/14	05/26	05/31	12/10	23	1410496
2003	04/03	04/27	05/01	05/03	05/15	05/27	06/04	10/01	25	841734
2004	04/03	04/29	05/11	05/15	05/29	06/12	06/16	09/16	29	309002

Figure B. 48: Historical outmigration run-timing of passage-indexed combined wild and hatchery run-at-large sockeye salmon at John Day Dam.

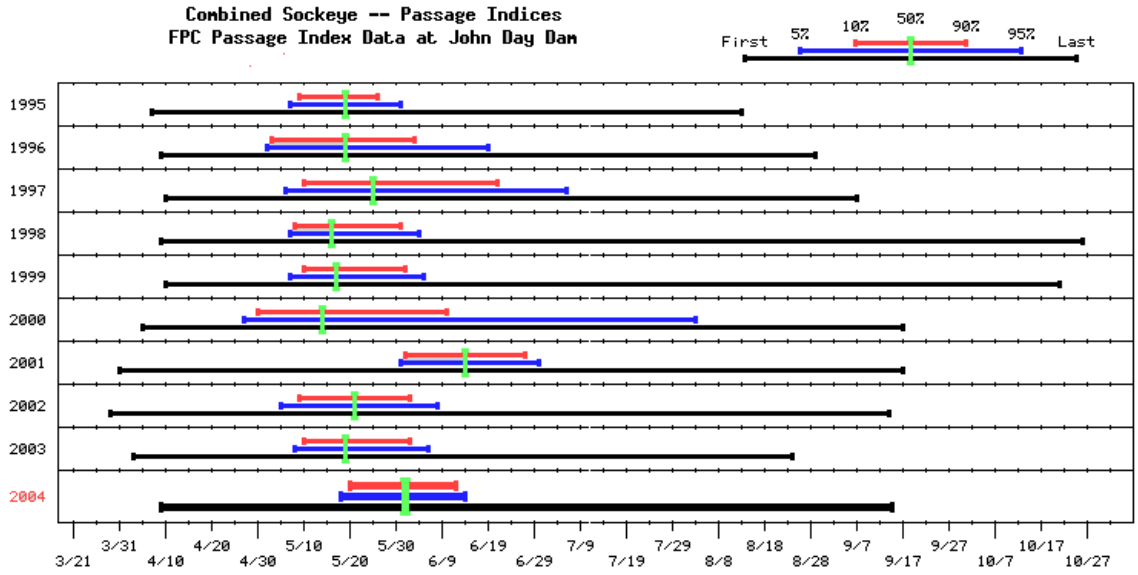


Table B. 48: Historical outmigration run-timing characteristics of passage-indexed combined wild and hatchery run-at-large sockeye salmon at John Day Dam.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total JDA Passage
1995	04/07	05/04	05/07	05/09	05/19	05/26	05/31	08/13	18	293076
1996	04/09	04/24	05/02	05/03	05/19	06/03	06/19	08/29	32	64594
1997	04/10	04/30	05/06	05/10	05/25	06/21	07/06	09/07	43	26490
1998	04/09	05/06	05/07	05/08	05/16	05/31	06/04	10/26	24	523673
1999	04/10	05/01	05/07	05/10	05/17	06/01	06/05	10/21	23	574059
2000	04/05	04/25	04/27	04/30	05/14	06/10	08/03	09/17	42	60091
2001	03/31	05/22	05/31	06/01	06/14	06/27	06/30	09/17	27	103971
2002	03/29	04/28	05/05	05/09	05/21	06/02	06/08	09/14	25	936132
2003	04/03	05/06	05/08	05/10	05/19	06/02	06/06	08/24	24	725830
2004	04/09	05/09	05/18	05/20	06/01	06/12	06/14	09/15	24	235929

Figure B. 49: Historical outmigration run-timing of passage-indexed combined wild and hatchery run-at-large sockeye salmon at Bonneville Dam.

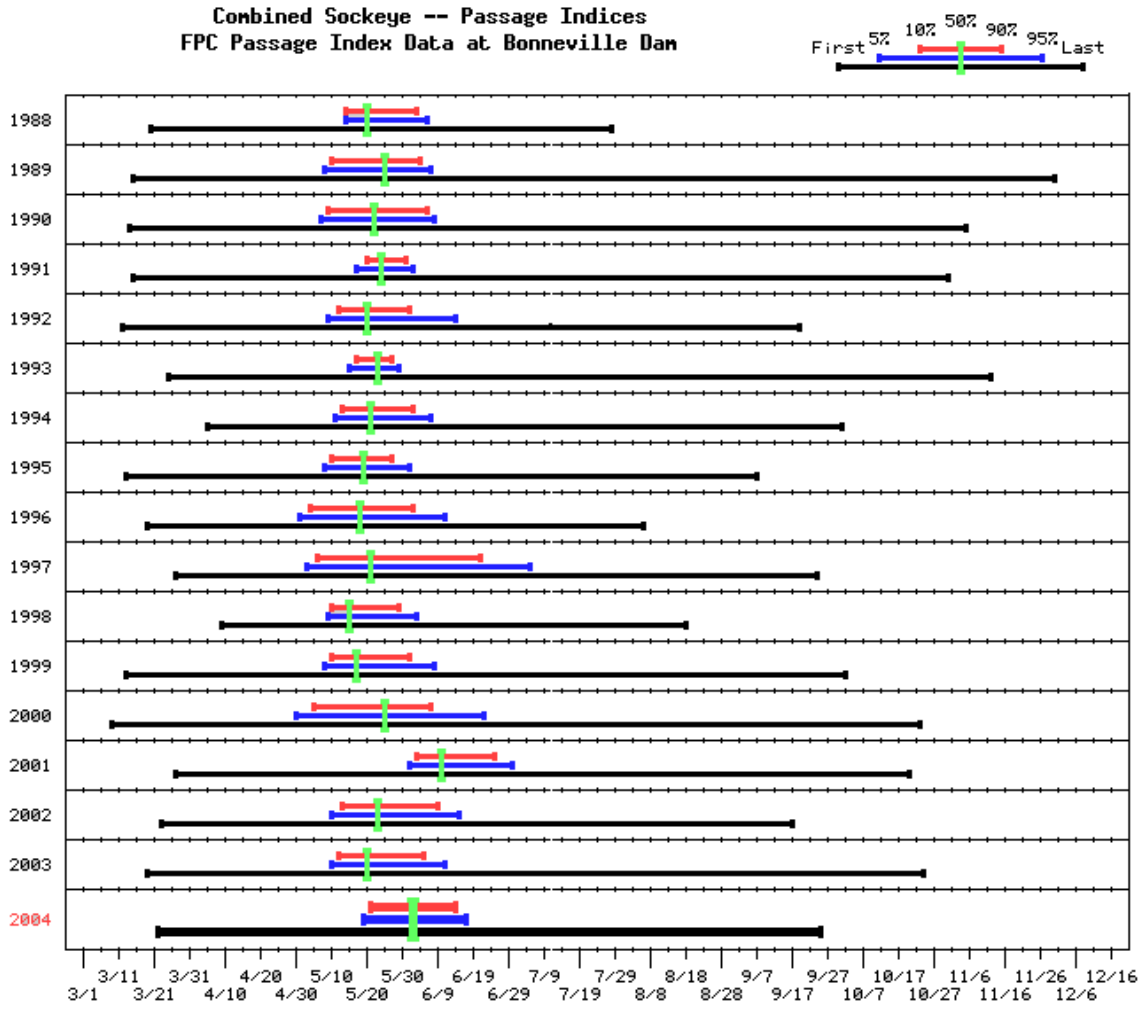


Table B. 49: Historical outmigration run-timing characteristics of passage-indexed combined wild and hatchery run-at-large sockeye salmon at Bonneville Dam.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total BON Passage
1988	03/20	05/11	05/14	05/14	05/20	06/03	06/06	07/28	21	77921
1989	03/15	05/02	05/08	05/10	05/25	06/04	06/07	11/30	26	138308
1990	03/14	05/02	05/07	05/09	05/22	06/06	06/08	11/05	29	81403
1991	03/15	05/06	05/17	05/20	05/24	05/31	06/02	10/31	12	147176
1992	03/12	04/07	05/09	05/12	05/20	06/01	06/14	09/19	21	10835
1993	03/25	05/14	05/15	05/17	05/23	05/27	05/29	11/12	11	538861
1994	04/05	05/08	05/11	05/13	05/21	06/02	06/07	10/01	21	87143
1995	03/13	05/06	05/08	05/10	05/19	05/27	06/01	09/07	18	263673
1996	03/19	04/21	05/01	05/04	05/18	06/02	06/11	08/06	30	37412
1997	03/27	04/28	05/03	05/06	05/21	06/21	07/05	09/24	47	31145
1998	04/09	05/07	05/09	05/10	05/15	05/29	06/03	08/18	20	114568
1999	03/13	04/28	05/08	05/10	05/17	06/01	06/08	10/02	23	118207
2000	03/09	04/19	04/30	05/05	05/25	06/07	06/22	10/23	34	65608
2001	03/27	05/23	06/01	06/03	06/10	06/25	06/30	10/20	23	106961
2002	03/23	05/04	05/10	05/13	05/23	06/09	06/15	09/17	28	849129
2003	03/19	05/09	05/10	05/12	05/20	06/05	06/11	10/24	25	1261379
2004	03/22	05/10	05/19	05/21	06/02	06/14	06/16	09/25	25	183774

Figure B. 50: Historical outmigration run-timing of passage-indexed combined wild and hatchery run-at-large subyearling chinook salmon at Rock Island Dam.

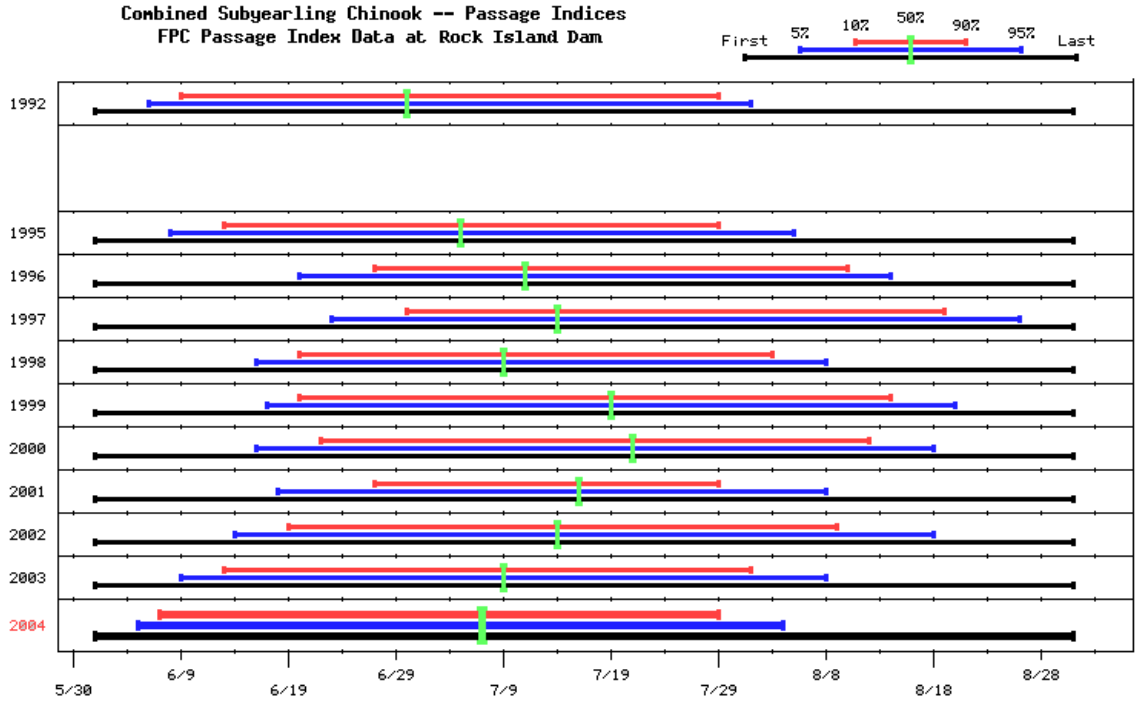


Table B. 50: Historical outmigration run-timing characteristics of passage-indexed combined wild and hatchery run-at-large subyearling chinook salmon at Rock Island Dam.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total RIS Passage
1992	06/01	06/02	06/06	06/09	06/30	07/29	08/01	08/31	51	10339
1995	06/01	06/02	06/08	06/13	07/05	07/29	08/05	08/31	47	14149
1996	06/01	06/08	06/20	06/27	07/11	08/10	08/14	08/31	45	15294
1997	06/01	06/08	06/23	06/30	07/14	08/19	08/26	08/31	51	19246
1998	06/01	06/09	06/16	06/20	07/09	08/03	08/08	08/31	45	17218
1999	06/01	06/04	06/17	06/20	07/19	08/14	08/20	08/31	56	28340
2000	06/01	06/05	06/16	06/22	07/21	08/12	08/18	08/31	52	13693
2001	06/01	06/04	06/18	06/27	07/16	07/29	08/08	08/31	33	22651
2002	06/01	06/04	06/14	06/19	07/14	08/09	08/18	08/31	52	25462
2003	06/01	06/04	06/09	06/13	07/09	08/01	08/08	08/31	50	28113
2004	06/01	06/01	06/05	06/07	07/07	07/29	08/04	08/31	53	25925

Figure B. 51: Historical outmigration run-timing of passage-indexed combined wild and hatchery run-at-large subyearling chinook salmon at McNary Dam.

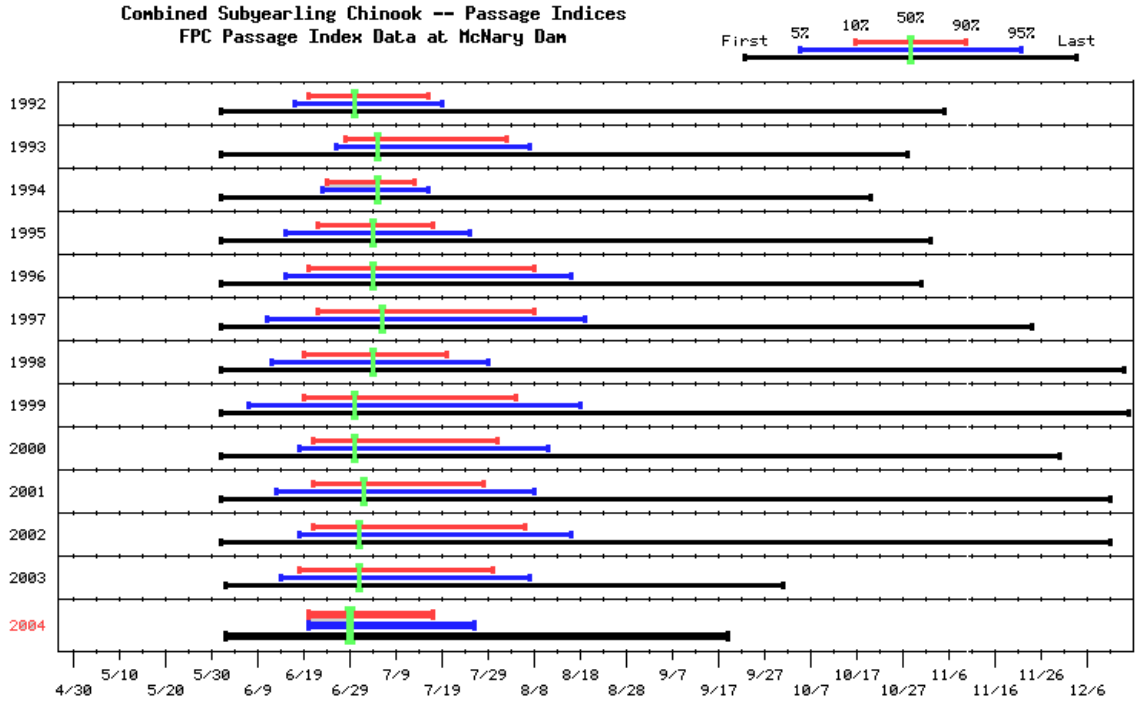


Table B. 51: Historical outmigration run-timing characteristics of passage-indexed combined wild and hatchery run-at-large subyearling chinook salmon at McNary Dam.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total MCN Passage
1992	06/01	06/12	06/17	06/20	06/30	07/16	07/19	11/05	27	6179484
1993	06/01	06/21	06/26	06/28	07/05	08/02	08/07	10/28	36	4283813
1994	06/01	06/17	06/23	06/24	07/05	07/13	07/16	10/20	20	5053511
1995	06/01	06/02	06/15	06/22	07/04	07/17	07/25	11/02	26	8223192
1996	06/01	06/03	06/15	06/20	07/04	08/08	08/16	10/31	50	6072944
1997	06/01	06/03	06/11	06/22	07/06	08/08	08/19	11/24	48	10383928
1998	06/01	06/03	06/12	06/19	07/04	07/20	07/29	12/14	32	11440908
1999	06/01	06/03	06/07	06/19	06/30	08/04	08/18	12/15	47	7645173
2000	06/01	06/07	06/18	06/21	06/30	07/31	08/11	11/30	41	10661814
2001	06/01	06/03	06/13	06/21	07/02	07/28	08/08	12/11	38	10777847
2002	06/01	06/05	06/18	06/21	07/01	08/06	08/16	12/11	47	8397324
2003	06/02	06/04	06/14	06/18	07/01	07/30	08/07	10/01	43	7682087
2004	06/02	06/06	06/20	06/20	06/29	07/17	07/26	09/19	28	8414454

Figure B. 52: Historical outmigration run-timing of passage-indexed combined wild and hatchery run-at-large subyearling chinook salmon at John Day Dam.

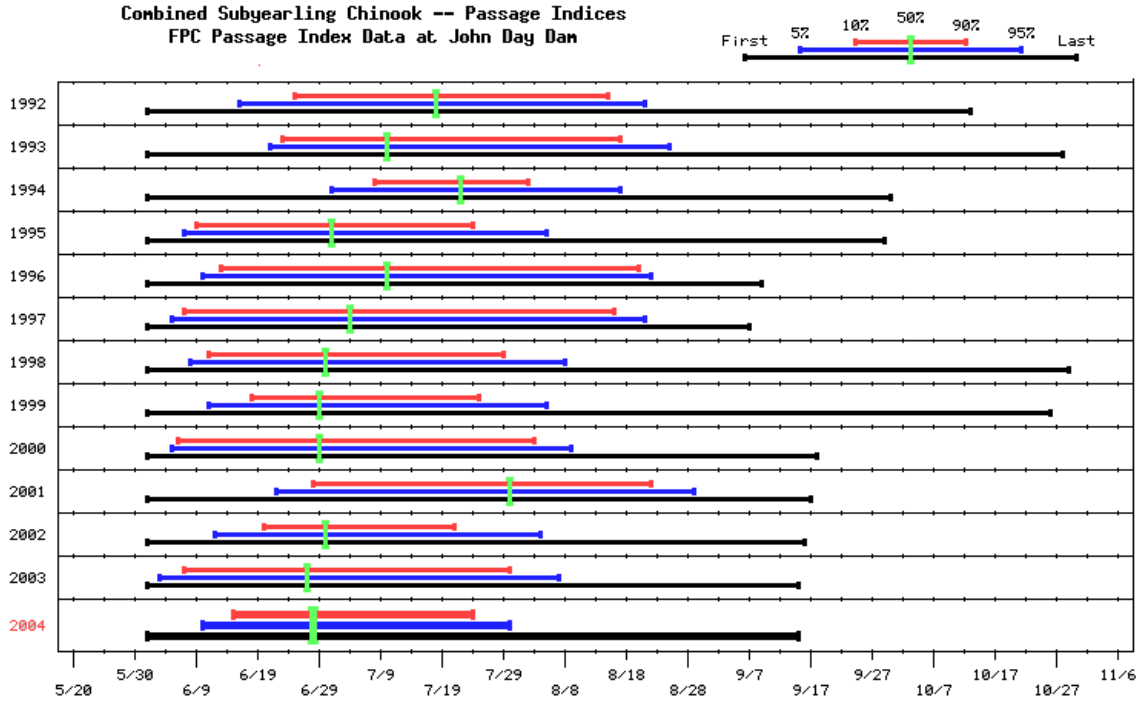


Table B. 52: Historical outmigration run-timing characteristics of passage-indexed combined wild and hatchery run-at-large subyearling chinook salmon at John Day Dam.

	Detection Date								Middle 80% (days)	Total JDA Passage
Detection Year	First	1%	5%	10%	50%	90%	95%	Last		
1992	06/01	06/13	06/16	06/25	07/18	08/15	08/21	10/13	52	549586
1993	06/01	06/06	06/21	06/23	07/10	08/17	08/25	10/28	56	1252777
1994	06/01	06/21	07/01	07/08	07/22	08/02	08/17	09/30	26	1207389
1995	06/01	06/03	06/07	06/09	07/01	07/24	08/05	09/29	46	1240275
1996	06/01	06/06	06/10	06/13	07/10	08/20	08/22	09/09	69	737912
1997	06/01	06/02	06/05	06/07	07/04	08/16	08/21	09/07	71	444651
1998	06/01	06/02	06/08	06/11	06/30	07/29	08/08	10/29	49	2155342
1999	06/01	06/05	06/11	06/18	06/29	07/25	08/05	10/26	38	3962629
2000	06/01	06/02	06/05	06/06	06/29	08/03	08/09	09/18	59	1664301
2001	06/01	06/12	06/22	06/28	07/30	08/22	08/29	09/17	56	2849766
2002	06/01	06/05	06/12	06/20	06/30	07/21	08/04	09/16	32	3465700
2003	06/01	06/02	06/03	06/07	06/27	07/30	08/07	09/15	54	2713873
2004	06/01	06/03	06/10	06/15	06/28	07/24	07/30	09/15	40	1720827

Figure B. 53: Historical outmigration run-timing of passage-indexed combined wild and hatchery run-at-large subyearling chinook salmon at Bonneville Dam.

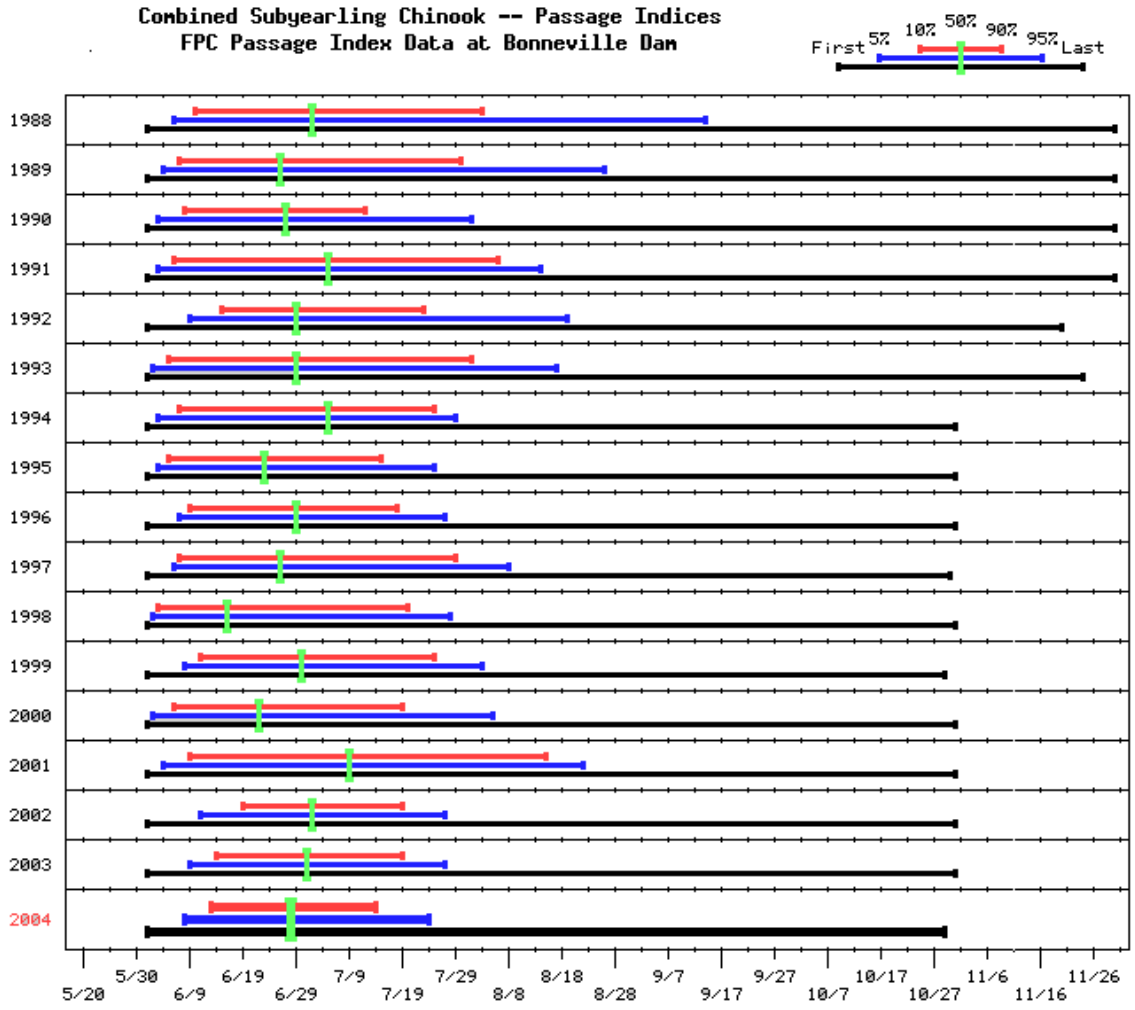


Table B. 53: Historical outmigration run-timing characteristics of passage-indexed combined wild and hatchery run-at-large subyearling chinook salmon at Bonneville Dam.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total BON Passage
1988	06/01	06/02	06/06	06/10	07/02	08/03	09/14	11/30	55	333582
1989	06/01	06/01	06/04	06/07	06/26	07/30	08/26	11/30	54	361716
1990	06/01	06/02	06/03	06/08	06/27	07/12	08/01	11/30	35	929116
1991	06/01	06/01	06/03	06/06	07/05	08/06	08/14	11/30	62	754560
1992	06/01	06/03	06/09	06/15	06/29	07/23	08/19	11/20	39	985437
1993	06/01	06/01	06/02	06/05	06/29	08/01	08/17	11/24	58	772276
1994	06/01	06/01	06/03	06/07	07/05	07/25	07/29	10/31	49	1127627
1995	06/01	06/01	06/03	06/05	06/23	07/15	07/25	10/31	41	1605396
1996	06/01	06/03	06/07	06/09	06/29	07/18	07/27	10/31	40	696569
1997	06/01	06/03	06/06	06/07	06/26	07/29	08/08	10/30	53	1090472
1998	06/01	06/01	06/02	06/03	06/16	07/20	07/28	10/31	48	928458
1999	06/01	06/04	06/08	06/11	06/30	07/25	08/03	10/29	45	1195205
2000	06/01	06/01	06/02	06/06	06/22	07/19	08/05	10/31	44	772819
2001	06/01	06/01	06/04	06/09	07/09	08/15	08/22	10/31	68	2170478
2002	06/01	06/04	06/11	06/19	07/02	07/19	07/27	10/31	31	5192192
2003	06/01	06/03	06/09	06/14	07/01	07/19	07/27	10/31	36	6015618
2004	06/01	06/02	06/08	06/13	06/28	07/14	07/24	10/29	32	2662730

Figure B. 54: Historical outmigration run-timing of passage-indexed combined wild and hatchery run-at-large subyearling chinook salmon at Bonneville Dam, including hatchery releases starting as early as March.

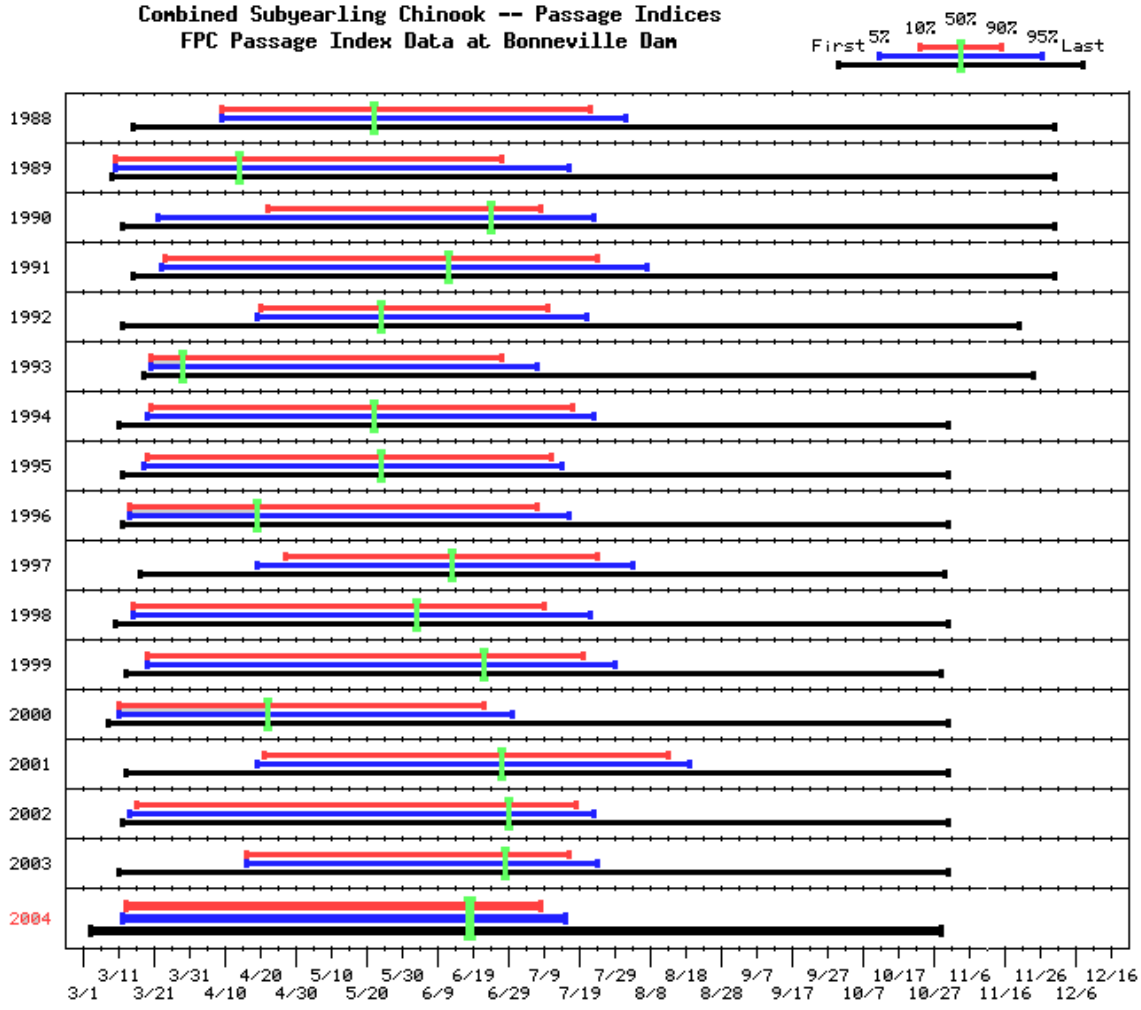


Table B. 54: Historical outmigration run-timing characteristics of passage-indexed combined wild and hatchery run-at-large subyearling chinook salmon at Bonneville Dam, including hatchery releases starting as early as March.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total BON Passage
1988	03/15	04/08	04/09	04/09	05/22	07/22	08/01	11/30	105	724096
1989	03/09	03/10	03/10	03/10	04/14	06/27	07/16	11/30	110	1756758
1990	03/12	03/16	03/22	04/22	06/24	07/08	07/23	11/30	78	1219786
1991	03/15	03/22	03/23	03/24	06/12	07/24	08/07	11/30	123	1257383
1992	03/12	03/19	04/19	04/20	05/24	07/10	07/21	11/20	82	2320366
1993	03/18	03/20	03/20	03/20	03/29	06/27	07/07	11/24	100	4339391
1994	03/11	03/19	03/19	03/20	05/22	07/17	07/23	10/31	120	3607433
1995	03/12	03/17	03/18	03/19	05/24	07/11	07/14	10/31	115	3406406
1996	03/12	03/14	03/14	03/14	04/19	07/07	07/16	10/31	116	1921838
1997	03/17	03/18	04/19	04/27	06/13	07/24	08/03	10/30	89	1499549
1998	03/10	03/14	03/15	03/15	06/03	07/09	07/22	10/31	117	1591880
1999	03/13	03/19	03/19	03/19	06/22	07/20	07/29	10/29	124	1692673
2000	03/08	03/11	03/11	03/11	04/22	06/22	06/30	10/31	104	3814911
2001	03/13	03/13	04/19	04/21	06/27	08/13	08/19	10/31	115	2940641
2002	03/12	03/14	03/14	03/16	06/29	07/18	07/23	10/31	125	7075267
2003	03/11	03/11	04/16	04/16	06/28	07/16	07/24	10/31	92	7903922
2004	03/03	03/05	03/12	03/13	06/18	07/08	07/15	10/29	118	4577937

Appendix C

Daily Expansion Factors for Spill-Adjusted PIT-Tagged Stocks Forecasted by Project RealTime in the 2004 Migration, including Chinook Salmon and Steelhead Trout at Lower Granite Dam and salmonids tracked to McNary Dam

Table C. 1: Expansion factors used to adjust PIT-tag detections based on outflow and spill at Lower Granite and McNary Dams during 2004 migration. See section 2.1.1. for expansion equations.

Date	Lower Granite Dam				McNary Dam		
	Outflow (kcfs)	Spill (kcfs)	Expansion factor (eq.s 2.2a, b)		Outflow (kcfs)	Spill (kcfs)	Expansion factor (Eq. 2.2c)
			Chinook	Steelhead			
04/01	50.4	0.0	1.00	1.00	126.6	0.1	1.00
04/02	48.2	0.0	1.00	1.00	139.1	0.4	1.00
04/03	39.3	4.6	1.35	1.32	145.6	0.0	1.00
04/04	44.9	18.2	2.66	2.16	135.7	0.0	1.00
04/05	44.8	19.3	2.80	2.25	119.7	0.0	1.00
04/06	54.4	24.1	2.87	2.29	119.0	0.0	1.00
04/07	48.8	18.8	2.55	2.10	144.4	0.0	1.00
04/08	52.8	15.3	2.07	1.81	120.0	0.0	1.00
04/09	54.7	24.3	2.88	2.30	129.3	0.0	1.00
04/10	49.5	18.7	2.51	2.08	128.4	0.0	1.00
04/11	49.2	18.7	2.52	2.08	128.8	0.0	1.00
04/12	46.8	18.5	2.61	2.13	152.4	29.5	1.24
04/13	54.6	18.3	2.29	1.94	131.2	40.3	1.44
04/14	58.0	18.2	2.18	1.88	148.2	47.0	1.46
04/15	64.2	18.4	2.05	1.80	178.3	63.8	1.56
04/16	56.6	18.3	2.23	1.91	189.1	64.5	1.52
04/17	50.9	18.3	2.42	2.02	165.0	37.1	1.29
04/18	49.6	18.3	2.46	2.05	159.3	41.9	1.36
04/19	46.8	18.3	2.58	2.12	166.9	55.8	1.50
04/20	45.2	18.4	2.67	2.17	198.7	66.2	1.50
04/21	43.8	18.5	2.75	2.22	196.1	67.9	1.53
04/22	42.4	18.6	2.84	2.28	171.6	55.9	1.48
04/23	42.1	4.6	1.33	1.30	154.1	45.7	1.42
04/24	40.1	0.0	1.00	1.00	155.0	39.1	1.34
04/25	41.5	0.0	1.00	1.00	153.1	33.4	1.28
04/26	41.8	0.0	1.00	1.00	154.1	37.3	1.32
04/27	45.6	0.0	1.00	1.00	169.7	53.2	1.46
04/28	54.6	0.0	1.00	1.00	179.3	55.5	1.45
04/29	54.1	0.0	1.00	1.00	175.4	58.0	1.49
04/30	54.7	0.0	1.00	1.00	166.5	55.1	1.49
05/01	50.1	0.0	1.00	1.00	164.7	52.1	1.46
05/02	50.3	0.0	1.00	1.00	164.5	52.9	1.47
05/03	60.9	0.0	1.00	1.00	170.2	57.4	1.51
05/04	70.4	0.0	1.00	1.00	206.9	87.2	1.73
05/05	79.1	3.7	1.13	1.11	226.0	98.7	1.78
05/06	85.3	2.6	1.08	1.06	219.7	91.6	1.72
05/07	80.5	0.0	1.00	1.00	211.6	81.8	1.63
05/08	78.7	0.0	1.00	1.00	202.2	87.3	1.76
05/09	75.2	0.0	1.00	1.00	201.5	82.3	1.69
05/10	73.1	0.0	1.00	1.00	216.8	97.0	1.81
05/11	72.2	0.0	1.00	1.00	224.8	95.4	1.74
05/12	72.1	0.0	1.00	1.00	221.6	98.1	1.79
05/13	64.1	0.0	1.00	1.00	210.4	85.8	1.69
05/14	59.5	0.0	1.00	1.00	209.2	86.1	1.70
05/15	57.9	0.0	1.00	1.00	200.6	86.2	1.75
05/16	55.9	0.0	1.00	1.00	188.9	80.4	1.74
05/17	68.2	0.0	1.00	1.00	204.1	88.4	1.76

Table C. 1: Expansion factors (continued).

Date	Lower Granite Dam				McNary Dam		
	Outflow (kcfs)	Spill (kcfs)	Expansion factor (eq.s 2.2a, b) Chinook	Steelhead	Outflow (kcfs)	Spill (kcfs)	Expansion factor (Eq. 2.2c)
05/18	64.9	0.0	1.00	1.00	208.7	89.6	1.75
05/19	67.7	0.0	1.00	1.00	207.1	90.0	1.77
05/20	75.5	0.0	1.00	1.00	234.3	99.8	1.74
05/21	77.6	0.0	1.00	1.00	215.3	92.2	1.75
05/22	83.6	0.0	1.00	1.00	214.9	90.1	1.72
05/23	84.6	0.0	1.00	1.00	212.6	91.9	1.76
05/24	89.7	0.0	1.00	1.00	209.0	91.9	1.78
05/25	86.7	0.0	1.00	1.00	207.3	91.4	1.79
05/26	84.2	0.0	1.00	1.00	234.3	106.6	1.83
05/27	92.8	4.4	1.13	1.11	240.0	91.4	1.62
05/28	122.4	29.9	1.86	1.68	273.7	103.2	1.61
05/29	132.4	39.4	2.10	1.83	269.8	111.6	1.71
05/30	125.8	34.2	1.98	1.76	238.4	94.2	1.65
05/31	120.8	28.4	1.82	1.65	265.6	112.5	1.73
06/01	114.8	22.2	1.64	1.54	257.9	107.0	1.71
06/02	103.1	11.4	1.33	1.30	246.9	81.2	1.49
06/03	100.4	18.9	1.62	1.52	232.8	78.1	1.50
06/04	105.1	22.5	1.73	1.59	255.5	91.3	1.56
06/05	108.9	19.0	1.56	1.48	279.9	111.6	1.66
06/06	108.3	20.5	1.62	1.52	225.4	76.6	1.51
06/07	110.6	21.7	1.65	1.54	239.9	79.3	1.49
06/08	102.0	9.5	1.27	1.25	239.0	74.6	1.45
06/09	97.6	5.6	1.16	1.14	234.0	73.7	1.46
06/10	90.5	0.0	1.00	1.00	236.9	85.1	1.56
06/11	88.1	0.0	1.00	1.00	253.3	88.3	1.54
06/12	83.8	0.0	1.00	1.00	253.6	85.8	1.51
06/13	77.2	0.0	1.00	1.00	242.1	72.8	1.43
06/14	76.5	0.0	1.00	1.00	234.2	71.5	1.44
06/15	72.6	0.0	1.00	1.00	241.2	74.9	1.45
06/16	60.7	0.0	1.00	1.00	247.0	75.4	1.44
06/17	55.2	0.0	1.00	1.00	205.3	75.4	1.58
06/18	53.5	0.0	1.00	1.00	209.1	74.5	1.55
06/19	49.3	0.0	1.00	1.00	194.0	71.7	1.59
06/20	48.7	0.0	1.00	1.00	184.9	66.1	1.56
06/21	46.2	0.0	1.00	1.00	211.3	72.2	1.52
06/22	52.1	0.0	1.00	1.00	204.1	67.2	1.49
06/23	48.4	0.0	1.00	1.00	189.9	31.9	1.20
06/24	54.4	0.0	1.00	1.00	174.2	0.0	1.00
06/25	52.9	0.0	1.00	1.00	174.7	0.0	1.00
06/26	43.6	0.0	1.00	1.00	168.3	0.0	1.00
06/27	44.3	0.0	1.00	1.00	166.6	0.0	1.00
06/28	43.4	0.0	1.00	1.00	174.7	7.7	1.05
06/29	38.4	0.0	1.00	1.00	187.6	15.2	1.09
06/30	38.2	0.0	1.00	1.00	198.7	26.7	1.16
07/01	42.1	0.0	1.00	1.00	189.8	19.7	1.12
07/02	41.3	0.0	1.00	1.00	166.9	0.0	1.00
07/03	43.9	0.0	1.00	1.00	136.9	0.0	1.00
07/04	37.3	0.0	1.00	1.00	144.9	0.0	1.00
07/05	36.2	0.0	1.00	1.00	160.7	0.0	1.00
07/06	36.5	0.0	1.00	1.00	169.1	0.0	1.00

Table C. 1: Expansion factors (continued).

Date	Lower Granite Dam				McNary Dam		
	Outflow (kcfs)	Spill (kcfs)	Expansion factor (eq.s 2.2a, b)		Outflow (kcfs)	Spill (kcfs)	Expansion factor (Eq. 2.2c)
			Chinook	Steelhead			
07/07	36.7	0.0	1.00	1.00	168.7	0.0	1.00
07/08	36.7	0.0	1.00	1.00	163.0	0.0	1.00
07/09	39.0	0.0	1.00	1.00	173.8	0.0	1.00
07/10	33.7	0.0	1.00	1.00	149.0	0.0	1.00
07/11	35.2	0.0	1.00	1.00	135.4	0.0	1.00
07/12	37.8	0.0	1.00	1.00	155.3	0.0	1.00
07/13	39.3	0.0	1.00	1.00	164.2	0.0	1.00
07/14	40.6	0.0	1.00	1.00	168.2	0.0	1.00
07/15	37.6	0.0	1.00	1.00	152.4	0.0	1.00
07/16	37.6	0.0	1.00	1.00	125.0	0.0	1.00
07/17	35.7	0.0	1.00	1.00	126.5	0.0	1.00
07/18	34.3	0.0	1.00	1.00	106.1	0.0	1.00
07/19	32.4	0.0	1.00	1.00	146.6	0.0	1.00
07/20	35.8	0.0	1.00	1.00	120.0	0.0	1.00
07/21	32.5	0.0	1.00	1.00	121.0	0.0	1.00
07/22	35.8	0.0	1.00	1.00	111.8	0.0	1.00
07/23	34.4	0.0	1.00	1.00	126.7	0.0	1.00
07/24	32.9	0.0	1.00	1.00	115.6	0.0	1.00
07/25	31.5	0.0	1.00	1.00	117.8	0.0	1.00
07/26	32.1	0.0	1.00	1.00	129.7	0.0	1.00
07/27	28.8	0.0	1.00	1.00	116.2	0.0	1.00
07/28	27.3	0.0	1.00	1.00	142.3	0.0	1.00
07/29	28.7	0.0	1.00	1.00	137.5	0.0	1.00
07/30	29.4	0.0	1.00	1.00	149.9	0.0	1.00
07/31	26.6	0.0	1.00	1.00	144.4	0.0	1.00
08/01	26.6	0.0	1.00	1.00	114.2	0.0	1.00
08/02	27.6	0.0	1.00	1.00	118.7	0.0	1.00
08/03	28.9	0.0	1.00	1.00	117.8	0.0	1.00
08/04	26.3	0.0	1.00	1.00	116.4	0.0	1.00
08/05	29.5	0.2	1.02	1.00	120.8	0.0	1.00
08/06	28.0	0.0	1.00	1.00	105.7	0.0	1.00
08/07	25.3	0.0	1.00	1.00	100.6	0.0	1.00
08/08	25.7	0.0	1.00	1.00	74.3	0.0	1.00
08/09	25.5	0.0	1.00	1.00	113.5	0.0	1.00
08/10	25.8	0.0	1.00	1.00	125.8	0.0	1.00
08/11	26.8	0.0	1.00	1.00	155.1	0.0	1.00
08/12	28.8	0.0	1.00	1.00	136.1	0.0	1.00
08/13	23.6	0.0	1.00	1.00	126.4	0.0	1.00
08/14	23.9	0.0	1.00	1.00	115.3	0.0	1.00
08/15	23.8	0.0	1.00	1.00	100.7	0.0	1.00
08/16	24.0	0.0	1.00	1.00	135.7	0.0	1.00
08/17	24.9	0.0	1.00	1.00	126.0	0.0	1.00
08/18	22.8	0.0	1.00	1.00	135.6	0.0	1.00
08/19	24.7	0.0	1.00	1.00	148.1	0.0	1.00
08/20	25.8	0.0	1.00	1.00	146.4	0.0	1.00
08/21	27.1	0.0	1.00	1.00	137.7	0.0	1.00
08/22	26.0	0.0	1.00	1.00	91.6	0.0	1.00
08/23	24.3	0.0	1.00	1.00	102.5	0.0	1.00
08/24	27.5	0.0	1.00	1.00	110.9	0.0	1.00
08/25	28.0	0.0	1.00	1.00	102.7	0.0	1.00

Table C. 1: Expansion factors (continued).

Date	Lower Granite Dam				McNary Dam		
	Outflow (kcfs)	Spill (kcfs)	Expansion factor (eq.s 2.2a, b)		Outflow (kcfs)	Spill (kcfs)	Expansion factor (Eq. 2.2c)
			Chinook	Steelhead			
08/26	30.4	0.0	1.00	1.00	136.9	0.0	1.00
08/27	32.4	0.0	1.00	1.00	155.4	0.0	1.00
08/28	33.2	0.0	1.00	1.00	146.9	0.0	1.00
08/29	29.7	0.0	1.00	1.00	136.0	0.0	1.00
08/30	27.4	0.0	1.00	1.00	152.8	0.0	1.00
08/31	31.6	0.0	1.00	1.00	149.4	0.0	1.00
09/01	31.0	0.0	1.00	1.00	171.5	27.3	1.19
09/02	26.5	0.0	1.00	1.00	146.6	9.1	1.07
09/03	25.7	0.0	1.00	1.00	113.5	0.0	1.00
09/04	26.1	0.0	1.00	1.00	85.5	0.0	1.00
09/05	24.8	0.0	1.00	1.00	80.0	0.0	1.00
09/06	22.4	0.0	1.00	1.00	84.7	0.0	1.00
09/07	23.0	0.0	1.00	1.00	109.1	0.0	1.00
09/08	23.3	0.8	1.09	1.07	112.2	0.0	1.00
09/09	29.5	0.0	1.00	1.00	102.2	0.0	1.00
09/10	29.0	0.0	1.00	1.00	127.4	0.0	1.00
09/11	24.1	0.0	1.00	1.00	118.4	0.0	1.00
09/12	23.4	0.0	1.00	1.00	95.2	0.0	1.00
09/13	26.4	0.1	1.01	1.00	96.9	0.0	1.00
09/14	38.1	0.0	1.00	1.00	96.6	0.0	1.00
09/15	35.2	0.0	1.00	1.00	109.7	0.0	1.00
09/16	39.0	0.0	1.00	1.00	77.8	0.0	1.00
09/17	34.8	0.0	1.00	1.00	108.5	0.0	1.00
09/18	26.1	0.0	1.00	1.00	102.0	0.0	1.00
09/19	28.4	0.0	1.00	1.00	92.0	0.0	1.00
09/20	22.6	3.9	1.56	1.48	106.7	0.0	1.00
09/21	20.0	4.8	1.84	1.67	100.5	0.0	1.00
09/22	25.4	12.2	3.08	2.43	112.4	0.0	1.00
09/23	23.3	3.9	1.54	1.46	126.8	0.0	1.00
09/24	28.1	0.0	1.00	1.00	123.3	0.0	1.00
09/25	23.3	0.0	1.00	1.00	113.0	0.0	1.00
09/26	21.4	0.0	1.00	1.00	104.2	0.0	1.00
09/27	20.0	0.0	1.00	1.00	121.9	0.0	1.00
09/28	21.4	0.0	1.00	1.00	112.3	0.0	1.00
09/29	21.6	0.0	1.00	1.00	121.5	0.0	1.00
09/30	20.9	0.0	1.00	1.00	108.6	0.0	1.00

Appendix D

Historical MADs for Stocks Used in the 2004 RealTime Run-Timing Prediction Project

Table D. 1: Historical MADs (%) for all wild PIT-tagged yearling chinook salmon forecasted to Lower Granite Dam and McNary Dam in 2004.

Stock Name	Dam	Year									Hist. Avg.	2004
		1995	1996	1997	1998	1999	2000	2001	2002	2003		
Bear Valley Creek	Lower Granite Dam	4.9	---	---	8.0	7.3	3.8	7.8	4.8	6.2	6.1	12.5
Big Creek		3.8	---	---	---	2.9	6.4	---	7.7	4.0	5.0	2.2
Camas Creek		---	---	---	---	---	9.6	---	---	10.1	9.9	4.0
Cape Horn Creek		---	---	---	---	---	7.6	---	---	4.0	5.8	19.3
Catherine Creek		6.6	5.4	6.5	7.5	6.7	5.3	7.8	4.7	3.8	6.0	5.8
West Fork Chamberlain Creek		---	---	---	---	---	---	---	8.2	11.8	10.0	5.1
Elk Creek		7.2	---	---	14.8	4.1	3.7	---	16.2	12.1	9.7	7.2
Herd Creek		---	---	---	---	5.2	6.3	10.3	---	6.9	7.2	1.4
Imnaha River		9.0	8.4	3.8	10.2	3.4	3.2	5.9	32.6	3.0	8.8	3.1
Lake Creek		---	---	11.8	9.8	3.2	3.8	---	6.5	12.9	8.0	3.2
Lemhi River		---	---	---	---	---	---	---	8.5	38.9	23.7	17.1
Lolo Creek		---	---	---	---	---	---	---	10.5	11.3	10.9	1.5
Lookingglass Creek		---	---	---	---	---	---	---	8.0	5.4	6.7	5.1
Loon Creek		---	---	---	---	10.6	1.8	---	---	7.2	6.5	3.9
Lostine River		9.2	11.6	4.4	---	5.4	2.2	3.7	3.7	5.3	5.7	5.7
Marsh Creek		3.2	---	---	---	3.5	2.8	---	6.2	7.4	4.6	5.9
Minam River		8.9	3.0	7.6	8.6	6.2	2.3	1.8	4.6	5.9	5.4	9.1
South Fork Salmon River		5.1	6.7	5.9	4.7	5.1	3.3	5.8	8.2	23.5	7.6	3.0
Secesh River		3.6	8.2	8.4	6.9	3.6	3.9	10.1	3.4	17.7	7.3	3.3
Sulfur Creek		---	---	---	---	7.2	4.9	---	---	2.8	5.0	26.0
Valley Creek		8.9	---	---	---	8.8	6.4	12.5	3.9	5.9	7.7	5.5
CRiSP Composite		2.1	2.6	1.7	2.9	2.5	1.9	4.6	8.6	5.6	3.6	3.1
Snake River Run-at-large		---	---	---	---	---	1.8	4.0	5.5	4.6	4.0	5.2
Snake River Run-at-large	McNary	---	---	---	---	---	---	3.4	0.9	2.8	2.4	1.5

Table D. 2: Historical MADs (%) for all wild PIT-tagged steelhead trout forecasted to Lower Granite Dam and McNary Dam in 2004.

Stock Name	Dam	Year				Hist. Avg.	2004
		2000	2001	2002	2003		
Snake River Run-at-large	LGR	5.4	2.0	7.5	7.2	5.5	3.6
Snake River Run-at-large	McNary	---	1.5	5.0	7.5	4.7	4.4
Upper Columbia Run-at-large	McNary	---	5.9	12.1	6.9	8.3	6.6
Composite Snake River and Upper Columbia Run-at-large	McNary	---	2.5	4.6	5.5	4.2	5.7

Table D. 3: Historical MADs (%) for all wild and hatchery PIT-tagged sockeye salmon forecasted to Lower Granite Dam and McNary Dam in 2004.

Stock Name	Dam	Year							Hist. Avg.	2004
		1997	1998	1999	2000	2001	2002	2003		
Wild Snake River Run-at-large	McNary	---	---	---	---	6.7	5.1	11.3	7.7	23.6
Redfish Lake Hatchery	LGR	6.4	7.7	8.6	7.0	---	---	6.6	7.3	7.8

Table D. 4: Historical MADs (%) for all wild PIT-tagged subyearling chinook salmon forecasted to Lower Granite Dam and McNary Dam in 2004.

Stock Name	Dam	Year					Hist. Avg.	2004
		1999	2000	2001	2002	2003		
Snake River Run-at-large	LGR	5.0	5.3	5.2	5.4	2.8	4.7	5.3
Snake River Run-at-large	McNary	---	---	3.6	7.8	3.0	4.8	7.2
Upper Columbia Run-at-large	McNary	---	---	4.3	3.7	2.3	3.4	7.2

Table D. 5: Historical MADs (%) for the RealTime predicted run-timing using Fish Passage Center passage-indexed combined wild and hatchery runs-at-large of yearling chinook salmon at Rock Island, McNary, John Day, and Bonneville Dams.

	Year					
Dam	2000	2001	2002	2003	Historical Avg.	2004
Rock Island	3.8	8.6	1.7	2.8	4.2	4.0
McNary	0.6	1.9	3.3	1.9	1.9	3.6
John Day	---	---	3.5	4.1	3.8	2.0
Bonneville	---	---	---	---	---	2.1

Table D. 6: Historical MADs (%) for the RealTime predicted run-timing using Fish Passage Center passage-indexed combined wild and hatchery runs-at-large of steelhead trout at Rock Island, McNary, John Day, and Bonneville Dams.

	Year					
Dam	2000	2001	2002	2003	Historical Avg.	2004
Rock Island	3.6	4.5	3.0	2.2	3.3	2.7
McNary	4.1	3.8	4.8	6.3	4.8	13.5
John Day	---	---	4.2	3.0	3.6	7.3
Bonneville	---	---	---	---	---	6.4

Table D. 7: Historical MADs (%) for the RealTime predicted run-timing using Fish Passage Center passage-indexed combined wild and hatchery runs-at-large of coho salmon at Rock Island, McNary, John Day, and Bonneville Dams.

	Year					
Dam	2000	2001	2002	2003	Historical Avg.	2004
Rock Island	0.6	4.1	2.6	1.3	2.2	1.8
McNary	1.4	2.0	1.6	4.2	2.3	5.8
John Day	---	---	3.7	2.3	3.0	3.2
Bonneville	---	---	---	---	---	1.7